

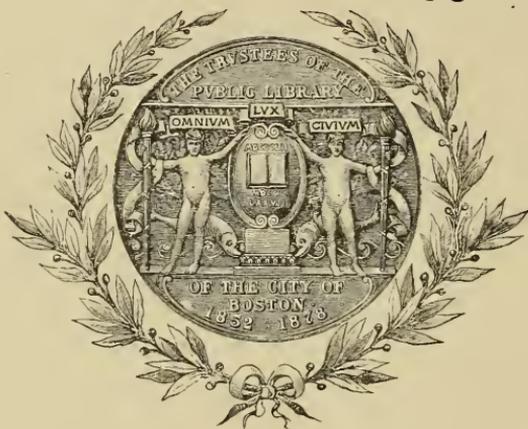
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NORTH AMERICAN FAUNA

No. 56

REVISION  
OF THE NORTH AMERICAN  
GROUND SQUIRRELS

With a Classification of the North American  
Sciuridae

By

ARTHUR H. HOWELL

Senior Biologist

Section of Wildlife Surveys, Division of Wildlife Research  
Bureau of Biological Survey



*Issued by*

UNITED STATES DEPARTMENT OF AGRICULTURE  
BUREAU OF BIOLOGICAL SURVEY

WASHINGTON, D. C.

APRIL 1938

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(Continued on page 3 of cover)

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UNITED STATES DEPARTMENT OF AGRICULTURE  
BUREAU OF BIOLOGICAL SURVEY

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April 1938

REVISION OF THE NORTH AMERICAN GROUND  
SQUIRRELS, WITH A CLASSIFICATION OF THE  
NORTH AMERICAN SCIURIDAE

By ARTHUR H. HOWELL, *senior biologist, Section of Wildlife Surveys  
Division of Wildlife Research*

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INTRODUCTION

The ground squirrels of North America now comprise 97 distinct forms in 31 species. These were arranged in the check list of Miller (1924)<sup>1</sup> under the four generic names *Citellus*, *Otospermophilus*, *Callospermophilus*, and *Ammospermophilus*. For many years there has been considerable uncertainty as to the relationships of the genera, subgenera, and species. As a result of the present study, the

<sup>1</sup> Citations in parentheses refer to the Bibliography, p. 217.

ground squirrels are now grouped under a single genus, *Citellus*, which is divided into eight subgenera.

The material on which the revision is based is principally contained in the collection of the United States National Museum, including that of the Bureau of Biological Survey. In addition, large series of specimens have been borrowed from several of the larger museums in the United States and Canada.<sup>2</sup> Altogether 11,724 specimens have been examined and identified.

One of the early bulletins of the Bureau—that on the Prairie Ground Squirrels, or Spermophiles, of the Mississippi Valley (Bailey, 1893)—treated of the habits of five of the more important species. Other writers have published reports on the habits and economic relationships of various other species, notably that by Grinnell and Dixon (1918) on the Natural History of the Ground Squirrels of California.

The group as a whole has not been revised for many years and there has been considerable uncertainty as to the relationships and the proper allocation of many of the species. This publication presents the results of a study of the systematic relationships and geographic distribution of the American members of the genus, with a summary of the known facts of their life history, together with a critical study of the systematic classification of all the North American members of the Sciuridae, the family of which the ground squirrels are members.

The colored plates (1 to 11) here reproduced were made about 40 years ago for the Biological Survey from drawings by Ernest E. Thompson, now known as Ernest Thompson Seton, and were printed in expectation that a report on the ground squirrels would soon be issued; although the revision for which the plates were made has been long delayed, it is now possible to present the illustrations in this volume.

#### GEOGRAPHIC DISTRIBUTION OF THE GROUND SQUIRRELS

Ground squirrels of the genus *Citellus* are widely distributed, both in North America and in Eurasia. The type species *C. citellus*, ranges from Bohemia eastward through the Union of Soviet-Socialist Republics into Asia, and the genus, represented in Eurasia by 20 or more described species, occupies parts of southeastern Europe and central Asia eastward into Siberia. Most of the Eurasian forms appear to be quite distinct from those of the New World, but

<sup>2</sup> For the loan of material used in this study the author extends thanks to the owners and custodians, as follows: R. M. Anderson, National Museum of Canada; F. Kermodé, Provincial Museum of British Columbia; Glover M. Allen, Museum of Comparative Zoölogy; Albert H. Wright, Cornell University; H. E. Anthony and G. G. Goodwin, American Museum of Natural History; Witmer Stone and Wharton Huber, Academy of Natural Sciences of Philadelphia; Earl L. Poole, Reading (Pa.) Public Museum; B. P. Bole, Jr., Cleveland (Ohio) Museum of Natural History; L. R. Dice, University of Michigan Museum of Zoölogy; William L. Engels, University of Notre Dame; W. H. Osgood, Field Museum of Natural History; W. H. Over, South Dakota Biological Survey; Myron H. Swenk, University of Nebraska; C. D. Bunker, Kansas University Museum of Birds and Mammals; Frederick W. Miller, Colorado Museum of Natural History; Ernest Morris, State Historical Society of Colorado, Denver; R. F. Crawford, State College of New Mexico; William H. Spaulding, Montana State College; J. S. Stanford, Utah State Agricultural College; Vasco M. Tanner, Brigham Young University; Joseph Grinnell and E. R. Hall, Museum of Vertebrate Zoölogy; Loye H. Miller, Los Angeles Museum; L. M. Huey, San Diego Society of Natural History; Chester Stock, California Institute of Technology; J. H. Fleming, Toronto, Ontario; C. B. Garrett, Cranbrook, British Columbia; P. F. Hickie, Lansing, Mich.; S. G. Jewett, Portland, Oreg.; E. T. Seton, Santa Fe, N. Mex.; William T. Shaw, Fresno, Calif.; Dayton Stoner, Albany, N. Y.; and Edward R. Warren, Colorado Springs, Colo.

those from eastern Siberia—*C. buxtoni* and *C. stejnegeri*—are closely related to the Alaskan species *C. parryii*.

The North American ground squirrels occupy a large part of the continent, from the Arctic coast of Alaska and Canada south to Guerrero and the valley of Mexico. Being inhabitants chiefly of prairies and open mountain slopes, they are absent from the forested regions of the eastern parts of both Canada and the United States. The large ground squirrels of the Barren Grounds (*C. parryii* and its relatives) range from the shores of Hudson Bay westward to the coast of Bering Sea and are found also in eastern Siberia and on St. Lawrence Island; the striped ground squirrels of the Mississippi Valley (*C. tridecemlineatus*) extend eastward to Michigan and Ohio; the gray ground squirrel of the prairies (*C. franklinii*) reaches Indiana in its eastward range, and a colony introduced into New Jersey 70 years ago still survives there. Practically the entire area of western North America, with the exception of the coast region of Washington and a large part of British Columbia, is occupied by one or more species of ground squirrel.

In the United States, ground squirrels are so abundant as to be highly destructive to agricultural crops. Their importance as factors limiting the profits of the farmer has long been recognized, and from its early days the Biological Survey has been called upon to direct extensive control campaigns in many parts of the West.

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**United States Department of Agriculture**  
**“Revision of the North American Ground Squirrels”**

CORRECTION SLIP—May Be Pasted at Foot of Page 3  
 Actual date of publication, May 18, 1938

- Page 41, line 8 from end: For  $\frac{3}{2}$ , read  $\frac{3}{4}$ .  
 Page 119, line 1: For county spelling, read Moffat.  
 Page 146, line 6 from end: For blank space in parentheses, insert  $\frac{1}{4}\frac{1}{2}$ .  
 Page 158, line 3 from end: In parenthetical measurements insert dash, to read 54.8–59.5.  
 Page 162, last line of section preceding *Notocitellus*: For 11, read 1 (San Pablo specimen).  
 Page 185, line 12: For 34.3, read 34.9 (skull length).

## HABITS AND ECONOMIC RELATIONS

The ground squirrels of North America differ from the tree squirrels in their habit of living in burrows and most of them become dormant for periods of varying extent, in some cases even more than half the year. During the periods of estivation and hibernation there is a decided drop in temperature, the respiration and blood circulation are reduced to a minimum, the body becomes rigid, and the fat accumulated during the active period is practically all consumed. When the animals emerge early in spring they feed sparingly at first on green vegetation and bulbs of wild plants or upon newly planted grain, if such is at hand. During the breeding season, which follows shortly after emergence from hibernation, the desire for green food increases and the squirrels feed on growing grain, alfalfa, wild herbs, and other succulent plants. Early in summer, as the season of estivation approaches, they turn their attention largely to the seeds of wild plants or to ripening grain; after feeding for a few weeks on such nutritious food they become excessively fat, and are ready to enter on their long sleep.

The fondness of certain of the ground squirrels for cultivated grain coupled with their ability to increase rapidly under favorable conditions, has made them one of the most serious pests with which the farmer has to contend. In addition to destroying immense quantities of grain and alfalfa, some species are destructive to cultivated fruits and nuts.

The burrowing of ground squirrels on steep slopes frequently is the initiating cause of soil erosion, which at times becomes serious. Grinnell and Dixon (1918, p. 608), write of the burrows of the California ground squirrels as follows:

\* \* \* their burrows are frequently the cause of much destructive erosion on hillsides during heavy rainstorms. Numerous small landslides have been noted on steep hillsides on the campus at Berkeley, that were plainly caused by the presence of squirrel burrows which had concentrated and conducted the water in narrow channels instead of permitting it to spread out and soak in or run off in the natural way.

Ground squirrel burrows are often a serious menace to the safety of irrigation systems. Birdseye (1912, p. 13) tells of a serious washout caused by irrigation water escaping through a Columbian ground squirrel's burrow located in an orchard on the bench above. Lantz (1918, p. 14) cites the destruction of 6 acres of alfalfa caused by the burrowing of a California ground squirrel into an irrigation embankment.

An additional count against certain of the ground squirrels is based on the part they play in the dissemination of diseases often fatal to man, as is the case with the Columbian ground squirrel in the spread of spotted fever, the California, Oregon, Uinta, Columbian, and Richardson's ground squirrels in the spread of bubonic plague, and the California ground squirrel and the Utah rock squirrel in the spread of tularemia.

The species that live on deserts or in mountainous sections are of little economic importance, since they rarely come in contact with agricultural operations. This is true of mantled ground squirrels (subgenus *Callospermophilus*), antelope ground squirrels (subgenus *Ammospermophilus*), round-tailed ground squirrels (subgenus *Xerospermophilus*), and spotted ground squirrels (*Citellus pilosoma*).

The most serious damage to man's interests is occasioned by various species of the typical subgenus (*Citellus*) and by the rock squirrels of the subgenus *Otospermophilus*. Franklin's ground squirrel (*C. franklinii*) and striped ground squirrels (*C. tridecemlineatus* and *C. mexicanus*) are accounted pests in some sections by reason of their destruction of newly planted corn and garden vegetables, but this damage is in part balanced by their destruction of injurious insects.

The species that occasion the greatest damage to crops of grain, and against which extensive control operations have been necessary, are the Columbian ground squirrel (*C. columbianus*), Richardson's and Wyoming ground squirrels (*C. richardsonii richardsonii* and *C. r. elegans*), Oregon ground squirrel (*C. beldingi oregonus*), Townsend's ground squirrel (*C. townsendii*), Washington ground squirrel (*C. washingtoni*), and Douglas's and California ground squirrels (*C. beecheyi* subsp.).

Detailed accounts of habits of various species follow.

#### TOWNSEND'S GROUND SQUIRREL AND RELATED RACES<sup>2a</sup>

*General habits.*—Townsend's ground squirrel and related races (*Citellus townsendii* subsp.) (pl. 1) inhabit dry, sandy, sagebrush valleys and to a lesser extent juniper-covered ridges among lava rocks. They live in dense colonies, digging their burrows under the sagebrush or sometimes out in the open. A burrow dug out by W. P. Taylor, in Humboldt County, Nev., was found to be about 30 feet in length, but only about 8 inches below the surface. Of this, Taylor (1911, p. 218) writes:

A nest was found in a large spherical cavity, so arranged that water could not have gotten into it. Fine straws made up the bulk of it, though white cotton twine had been very largely used to bind the straws loosely together. A couple of rags, a bit of rabbit fur, some wool, and a down feather were also incorporated into the nest. Apparently the burrows intercommunicate.

T. H. Scheffer excavated a burrow of the subspecies *C. t. townsendii* at Kennewick, Wash., which had been treated previously with carbon bisulphide. The mother squirrel and seven young were found strung along the course of the burrow, two of the latter in the nest. Scheffer (in manuscript) describes the burrow as follows:

The runway descended rather steeply from the entrance, reaching a depth of 5¼ feet at distance of 11 feet along the slope. From this point a branch ran downward to the right, for about 3 feet and ended in the nest chamber. Continuing slightly downgrade to a depth of 6 feet and a distance of 14 feet from the entrance, the main tunnel turned abruptly upward at an angle of about 70 degrees and reached the surface in a partly obstructed entrance 12 feet from the point where excavation was begun. From the place of this upward turn the main tunnel had been opened up 5 or 6 feet farther into looser

<sup>2a</sup> Formerly known as *Citellus mollis* subsp. For explanation of change of name see p. 62.

earth from an old badger digging. This material was slightly damp as a result of moisture penetrating through soil worked over by the badger long ago.

The nest chamber was about 6½ inches in most dimensions and was located just beneath the consolidated stratum, its roof hollowed out in the latter. It was filled with a perfectly dry nest consisting of fine grass partly broken and shredded. The two young found suffocated there were concealed in the nesting materials.

Like other species of their tribe, these ground squirrels hibernate during a good part of the year—from July to the following February. A single individual was seen at Blalock, Oreg., on February 1, 1926; Scheffer found the squirrels out in numbers at Kennewick, Wash., the last week in January; and R. Scott Zimmerman reports their appearance in Utah the latter part of February. In the Kennewick territory only a few stragglers were observed after June 20 and all of these apparently were young. In central Utah, however, a few were seen as late as September 12 (1932).

The young are born early in March, the litters numbering usually 7 to 10. Jewett (1923, p. 191) records taking a female carrying 13 embryos.

Although mainly terrestrial, these little squirrels occasionally climb to the tops of bushes, where they keep a sharp lookout for enemies. Their voice is described by Vernon Bailey as "a fine, prolonged, chippering whistle." Scheffer (in ms.) describes it as follows:

The notes or calls of this ground squirrel are very high pitched and comparatively faint, not nearly so sharp and clear as the chirp of a chipmunk of even smaller size. The more prolonged or sustained of the two common calls might readily be mistaken for the faint trill of an insect, while the clearer, chirping sound can scarcely be distinguished from certain notes of the horned lark. As the little animal enters its burrow on the nearer approach of suspected danger, it voices its final protest in chattering tones, faint but not uncertain.

*Food habits.*—Like most of the ground squirrels, this species feeds mainly on green vegetation in the early part of the season and later upon the seeds and stems of grasses and other plants. Scheffer, at Kennewick, Wash., observed them feeding on globemallow (*Sphaeralcea munroana*), silver Indianwheat (*Plantago purshii*), downy chess (*Bromus tectorum*), slender wheatgrass (*Agropyron pauciflorum*), Indian ricegrass (*Oryzopsis hymenoides*), and tumblemustard (*Norta altissima*), these being the same plants fed upon by *Citellus washingtoni* at Wallula, on the opposite side of the Columbia River. The squirrels have been reported to feed also on the leaves and seeds of sunflowers and the flowers of the bud sagebrush (*Artemisia spinescens*). They consume also grasshoppers, cicadas, and many other insects. When in contact with agricultural crops they become a serious pest, destroying alfalfa, wheat, barley, potatoes, beets, carrots, lettuce, and other garden vegetables. They were reported in 1917 to have practically destroyed a 10-acre field of beets at White Swan, Wash.

*Economic status.*—This species was found by Francis (1922, p. 8) to harbor the infection of tularemia.

#### SNAKE VALLEY GROUND SQUIRREL

The Snake Valley ground squirrel (*Citellus idahoensis*) has about the same habits as its near relative *C. townsendii mollis*. The squir-



TOWNSEND'S GROUND SQUIRREL (*CITELLUS TOWNSENDII* TOWNSENDII), UPPER.  
WASHINGTON GROUND SQUIRREL (*C. WASHINGTONI* WASHINGTONI), LOWER.



rels inhabit the dry sagebrush plains and overflow into cultivated lands, where they prove destructive to crops of grain, alfalfa, and vegetables. They are reported to emerge from their hibernating dens in March, and by the middle of July they begin their period of estivation. Each of four females taken at Nampa, Idaho, March 12, contained small embryos, numbering 8, 8, 9, and 10.

#### WASHINGTON GROUND SQUIRRELS<sup>2b</sup>

*General habits.*—Washington ground squirrels (*Citellus washingtoni* subsp.) (pl. 1) occupy the dry prairies of the Columbia Basin, east of the Columbia River. Vernon Bailey (in field notes) has described their habitat as follows:

The country which they inhabit is open and either dry and sandy, grassy, or sagebrush covered. They are most numerous along steep hillsides, in gulches, and in sagebrush along river bottoms. On the smooth, grassy prairie they are common and more evenly distributed. They collect where some protection is afforded by scattered bunches of sagebrush or *Chrysothamnus*, but avoid any dense cover from which they cannot look out on all sides.

Bailey estimated that in the section around Pendleton, Oreg., in 1896 these squirrels averaged 50 to 100 per acre in the colonies examined. On a measured acre on the prairie adjacent to a wheatfield he counted 620 burrows in addition to 62 larger holes dug by badgers in their search for the ground squirrels. The distribution of the squirrels, however, is not continuous, and over most of their range they are less abundant than this estimate would indicate.

A burrow of this species at Attalia, Wash., after having been fumigated with carbon bisulphide, was partly excavated by Scheffer, who states:

At a depth of 4½ feet and a distance of 11 feet down slope from the entrance, two half-grown squirrels were found suffocated. At 17 feet down slope from the entrance the burrow had reached a depth of 5½ feet, which level it followed 7 feet farther—24 feet in all. No branch burrow or nest had been found.

Scheffer found the Washington squirrels out of their burrows at Wallula, Wash., on January 25 (1926). They were out in numbers at Almota, Wash., on February 23. In mild seasons, single individuals often emerge from hibernation as early as January 9. The majority are reported to enter estivation during July, but Scheffer found that all had disappeared from their known haunts at Wallula and Attalia by June 16 (1925), when the weather was dry and hot. A few were seen at Coulee City as late as July 31, and one at Waterville, Wash., on August 4. The young are brought forth in February or early in March, and by the last of March they are able to run about and feed on green food.

The voice of the Washington squirrels is said to be very much like that of *Citellus townsendii mollis*—a soft, lisping whistle. When their suspicions are aroused, the squirrels stand up at full length on their hind feet and give their alarm note as they watch keenly for the appearance of an enemy. The alarm is then repeated on all sides by other members of the colony.

*Food habits.*—Bailey examined about 30 stomachs of this species at Pendleton, Oreg., and found the contents to be almost exclusively

<sup>2b</sup> Formerly known as Townsend's ground squirrel (*Citellus townsendii*). For explanation of change of name see p. 70.

of vegetable origin—green leaves, plant stems, wild flowers, bulbs, and seeds. Seeds of alfalfa constituted over half of the food and were found in almost every stomach. Insects, consisting of a large caterpillar, a few small beetles, and several cicadas, were found in four stomachs.

At Wallula, May 22 to 30, 1925, Scheffer studied the food habits of the Washington squirrels in detail, and made the following field notes:

Examinations of the stomachs showed that they were not gorged to repletion with green stuff as they had been earlier in the season, but were filled to a more moderate degree with bits of succulent stems, buds, seed pods, and seeds. Plants on which they were observed to be feeding were globemallow (*Sphaeralcea munroana*), silver Indianwheat (*Plantago purshii*), downy chess (*Bromus tectorum*), slender wheatgrass (*Agropyron pauciflorum*), Indian ricegrass (*Oryzopsis hymenoides*), tumbledustard (*Norta altissima*), and to a limited extent, alfalfa, oats, and wheat. In every case the direct observations were supplemented by examination of the plants on the feeding grounds. In the case of the grasses both heads and stems were being used for food; the favored part of the mallow seemed to be the small circular seed vessels, while only leaf tissue of the mustard appeared to be eaten.

*Economic status.*—By reason of their great abundance and their fondness for grain, these ground squirrels rank as one of the most serious of agricultural pests. They extend their depredations well into the fields of growing grain, cutting down the stalks and eating only the tenderest portions, or at a later stage selecting only the fruiting heads. In some fields, in a strip around the edge two rods or more in width they destroy more than half the grain. They also invade gardens and feed on young cabbage plants, green peas, and young corn.

#### RICHARDSON'S GROUND SQUIRREL

*General habits.*—Richardson's ground squirrel (*Citellus richardsonii richardsonii*) (pl. 2) lives on open prairies and on flats along the shores of lakes and rivers, seeming to prefer the sandy or gravelly ridges. In farming regions, the animals move into grainfields and pastures, and in some localities they occur in great abundance. Seton (1928, p. 261) describes a colony at Whitewater, Manitoba, which he estimated to number 10 squirrels to the acre. He states, also, that at Carberry, Manitoba, in the early eighties, he often noted as many as 50 on a single acre, and captured 20 within an hour in two traps. At the approach of an intruder, they stand flat on the hind feet, the body erect entirely off the ground and the front feet hanging down on the chest. This habit has given the species the common name of "picket pin." When alarmed they whistle vigorously and when chasing one another they squeal loudly. In entering their burrows, after halting at the entrance and lifting the head to watch the enemy, they go in head first usually switching the tail spasmodically. They quickly disappear with a final flirt of the tail, if danger still threatens.

James Silver excavated and measured nine burrows of this species in North Dakota and found that the tunnels varied in length from about 12 to 49 feet and in depth below the surface from 3 feet 10 inches to 5 feet 8 inches. Most of these burrows contained a cavity 6 to 9 inches in diameter in which was a nest made of dry or green grass, straw, and oat hulls.



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RICHARDSON'S GROUND SQUIRREL (CITELLUS RICHARDSONII RICHARDSONI).

Smith & Thompson



Apparently the dates of entering and leaving the hibernation dens vary considerably with local conditions. Ranchers in central Montana reported the squirrels as appearing in February, and Seton (1928, p. 264) quotes A. S. Barton in the statement that these squirrels came out during February (1905) in the country around Boissevain, Manitoba. At Cando, N. Dak., they were first observed in 1915 on March 10. In Alberta, on April 6, 1920, Francis Harper noted them in numbers at many points along a railroad between Calgary and Wetaskiwin.

In North Dakota, practically all the adults go into estivation in July, while the young remain above ground until September or later. At Waterton Lake, Mont., August 14, 1917, Vernon Bailey noted many burrows of this species but only a single animal, and thought that most of them had estivated on account of the drying up of the vegetation. At St. Mary Lakes, Mont., they were numerous and active on August 24. At Bismarck, N. Dak., most of the squirrels had denned up by September 1, but at Blackfoot, Mont., they were still numerous above ground on September 12, and at Van Hook, N. Dak., on October 16, one was seen out after a very cold night.

K. F. Ebner, of Cando, N. Dak., made notes on the disappearance of these squirrels in the fall of 1914; he stated that during the second week in September they appeared only on pleasant forenoons, and if disturbed would go into holes and remain the rest of the day; that after about October 1, they would remain in their burrows for 2, 3, and sometimes 4 days in succession, even in pleasant weather; and that none were seen from October 15 to November 2, but on the latter date they were unusually lively in the pasture.

Richardson's squirrels produce but one litter a year, numbering from 6 to 11, with an average of 7.5. The period of gestation, as determined by U. S. Ebner, from specimens kept in captivity, is about 28 to 32 days. The young squirrels appear above ground at various times from April 20 to June 1. Ebner dug out a number of burrows in fall, without finding any store of food.

The voice of this species is described as a short, shrill, whistling note. The animals are ordinarily not suspicious, and when taken young some make gentle and attractive pets, while others remain wild and vicious.

*Food habits.*—On the prairies, these squirrels subsist on the native grasses and flowering plants. They consume also seeds of various plants, including bindweed and sagebrush, and capture many grasshoppers and caterpillars. Grainfields attract them and there they destroy quantities of grain, both in narrow strips along the edges and also around their burrows in the middle of the field. Following planting they dig up and eat the seed grain. Early in the season they cut off and eat the succulent stems, and when the grain is ripening they pull down the stalks and cut off the heads.

Seton (1928, p. 270) tells of finding in the pouches of one of these ground squirrels 240 grains of wheat and nearly 1,000 grains of wild buckwheat. He records also finding about 2 quarts of sprouted wheat in a squirrel's den that had been raided by a badger in fall.

## WYOMING GROUND SQUIRREL

*General habits.*—The Wyoming ground squirrel (*Citellus richardsonii elegans*) inhabits the sage and greasewood plains, chiefly in the Transition Zone and partly in the Upper Sonoran. The animals reach comparatively high elevations in sections where grass-covered flats occur on a gravelly soil, but in general they avoid wooded or brush-covered areas. In many localities their burrows cover the ground more thickly than prairie dog mounds, and the population has been estimated to average at least 20 squirrels to the acre. The burrows are usually more numerous bordering cultivated fields, or in grassy patches in the semidesert regions. In irrigated districts, these squirrels concentrate in large numbers along roadways, railway embankments, and irrigation ditch banks, where the burrows are safe from the irrigation waters.

In the Green River Basin, Wyo., the first of these squirrels to emerge from hibernation were reported on April 2, and by April 12 they were out in great numbers. A female taken at Opal, Wyo., April 21, contained 5 small embryos. Burnett (1920, p. 8) records that 14 females examined in 1916 had an average of 8.2 young, and 19 examined in 1920 an average of 4.6. He states that the young are born about the middle of May. By the middle of August the squirrels are fat and ready to begin their long sleep underground. Bailey reports that at Meeker, Colo., most of the animals had gone into winter quarters by August 10, though several were seen on August 12. At Lay, Colo., A. G. Wallihan reports that they retire about the middle of July.

*Food habits.*—Stomachs of 5 adults examined at Elk Creek, Idaho, were largely filled with ripe fruit of *Amelanchier alnifolia*, together with green foliage, flowers of a composite, seeds of grasses, and a few remains of grasshoppers. Two individuals taken in the Laramie Mountains, Wyo., had their stomachs filled with the blossoms of rabbitbrush (*Chrysothamnus*), and one taken at Cheyenne had its pouches full of the heads of grama grass. A specimen of *C. r. nevadensis* taken in Malheur County, Oreg., had its pouches filled with 1,160 fruiting capsules with seeds of *Collomia*.

*Economic status.*—Wherever these ground squirrels come in contact with agricultural operations they become a serious pest. They consume large quantities of range grasses and in grainfields pull down the stalks and consume the heads of grain. They are especially destructive to growing barley and oats. Ranchmen in Moffatt County, Colo., claimed that in 1906 this species destroyed fully a third of the local rye crop and that they ruined a 5-acre field of oats in the same county. Carrots, radishes, lettuce, and other garden crops are sometimes damaged by these squirrels. Near Laramie, Wyo., a promising head-lettuce industry was threatened when the squirrels nibbled into the growing heads and so deformed them that an imperfect product resulted. Plague infection was demonstrated in a specimen of this squirrel taken in 1935 near Dillon, Mont. (Meyer, 1936, p. 964).

## UINTA GROUND SQUIRREL

*General habits.*—The Uinta ground squirrel (*Citellus armatus*) occupies dry meadows, pasture lands, and cultivated fields in high



BELDING'S GROUND SQUIRREL (*CITELLUS BELDINGI* BELDINGI).



valleys, and ranges in the mountain meadows nearly to timber line (Wind River Mountains, Wyo., 10,500 feet). The animals seem to prefer moist locations near water, especially where the vegetation is rank. They live in large colonies in burrows dug in soft soil in the meadows or along irrigation ditches. Occasionally they climb into bushes. Their voice is said to be louder than that of *C. elegans*; their call is described by Merritt Cary as "a sharp, vibrant, bird-like whistle, often terminating in a trill." According to O. E. Stepl, they have another call, consisting of three distinct notes, repeated rather slowly. Like some others of their tribe, they spend only about 5 months of the year above ground, the remaining period being spent in estivation and hibernation. In Yellowstone Park, nearly all the adults disappear by the middle of August and by the end of that month only an occasional immature individual is seen above ground. A very late record is that of a specimen collected at Mammoth Hot Springs, Yellowstone Park, October 4 (1902). The first to come out in spring appear usually from about April 5 to 11, though occasionally one may be seen as early as March 17.

*Food habits.*—Little of a definite nature is on record concerning the food habits of this species, but reports of field collectors show that, like other related species, these ground squirrels feed on green vegetation and dry seeds. Stomachs of 10 specimens examined by Vernon Bailey in Star Valley, Wyo., were full of green herbage, flowers of rabbitbrush (*Chrysothamnus*), and seeds of grasses and other plants. Two contained some golden currants (*Ribes aureum*). That these squirrels relish meat is evidenced by Bailey's statement that they ate two pocket gophers caught in his traps.

Living chiefly in mountainous country, the Uinta ground squirrels come in conflict with agricultural interests less frequently than do many of the other species, but wherever their range extends into cultivated valleys, they damage crops to some extent. Plague has been demonstrated in specimens of this squirrel taken in Bonneville County, Idaho, in 1936 (Meyer, 1936, p. 965).

#### BELDING'S GROUND SQUIRREL

*General habits.*—Belding's ground squirrel (*Citellus beldingi beldingi*) (pl. 3) inhabits mountain meadows near timber line in the Sierra Nevada and is only rarely found in open timber or brush lands. Their burrows are dug beneath stumps, logs, or rocks, or sometimes out in an open meadow, and frequently they appropriate the tunnels of pocket gophers (*Thomomys*) for their own use. The period of hibernation in this species is not definitely known but evidently in the high mountain meadows these squirrels are able to obtain an abundance of green food all summer and consequently they remain active considerably longer than do other species living in the dry valleys at lower altitudes. Grinnell and Dixon (1918, p. 664) report these squirrels numerous in Tioga Pass, Calif., on September 28 and some out as late as October 7 near Ten Lakes, Yosemite Park. At Lake Tahoe, J. A. Loring found them out in numbers on May 18. Grinnell and Storer (1924, p. 173) mention a specimen obtained at the Farrington ranch, near Williams Butte, on April 29, 1916. The young are born about the first of July.

The voice of this species is said to resemble that of the Oregon ground squirrel, according to Grinnell and Dixon (1918, p. 662)—

The usual call of warning consists of a series of from five to eight short shrill whistles uttered in quick succession and weakening toward the last. Females warn their young when foraging abroad with a lower-pitched, double note, or bark, *e-chert*. A single note, *sirt*, is also frequently heard.

*Food habits.*—Belding's ground squirrel feeds largely on the stems and seeds of wild grasses. C. Hart Merriam reports the species eating the flowers of beardtongue (*Pentstemon confertus*). Edmund C. Jaeger (1929, p. 91), writing of these squirrels as observed in July near Bishop Pass, Calif., says:

Their principal food at this time was the half-ripe seeds of a phacelia, the fruit of which was borne on stout stems about seven inches from the ground.

In Long Valley, Mono County, A. Brazier Howell (1924, p. 33) found them feeding extensively on a species of cicada (*Okanagana magnifica*). C. Sharsmith (1936, p. 12) records instances where these squirrels had killed a junco, an Audubon warbler, and a chipmunk. Since the range of Belding's squirrel lies above the zone of agriculture, the animal is of no special economic importance.

#### OREGON GROUND SQUIRREL

*General habits.*—The Oregon ground squirrel (*Citellus beldingi oregonus*) lives chiefly in mountain meadows but also in pastures, meadows, and grainfields in the valleys, and to a less extent in open pine forests. It avoids marshy ground as well as rocky or brushy slopes. It lives in large colonies, especially on ranches where food is abundant. Ira N. Gabrielson reports a count of 466 on a 2-acre tract in Klamath County, Oreg. On a ranch in Butte Valley, Calif., Grinnell and Dixon (1918, p. 654) estimated 560 burrows on 1 acre. One burrow they excavated was 66 feet long, including the various windings and its branches; its greatest depth below the surface was 45 inches.

These squirrels are almost exclusively ground dwellers; very rarely have they been observed to climb into bushes to obtain seeds. Their voice is described by Bailey as "a rattling *chipper*, or series of sharp *chips* so rapidly uttered that they almost blend into a prolonged trill."

*Hibernation.*—The Oregon ground squirrel spends more than half the year in a dormant condition. The date of entering hibernating quarters varies with the dryness of the summer and the supply of green vegetation. During some seasons, in the valleys, most of the squirrels disappear by July 10, but in seasons of greater rainfall they remain out several weeks longer; in the mountains, small numbers may be seen above ground as late as the first of September. In spring they begin to appear about the middle of February and by the first week in March are usually out in force, even if obliged to burrow through a foot or more of snow to reach the surface. At low altitudes in Umatilla County, Oreg., some have been reported out as early as January 22.

*Breeding.*—This species produces one litter of young a year, varying in number from 4 to 12, with an average of about 8. The young, born about April 10 to 20, appear above ground about May 10. In Butte Valley, Calif., on May 16, Grinnell and Dixon (1918, p. 658) report young out of the burrows in numbers, all about one-fourth to one-third grown.



COLUMBIAN GROUND SQUIRREL (*CITELLUS COLUMBIANUS COLUMBIANUS*).



*Food habits.*—The food of the Oregon ground squirrel consists mainly of green vegetation. In addition to grasses and cultivated grain, the following plants have been identified in the stomachs or cheek pouches: Flowers, stems, and leaves of camas (*Quamasia quash*), buttercup (*Ranunculus*), springbeauty (*Claytonia*), shootingstar (*Dodecatheon*), mule-ears (*Wyethia amplexicaulis*), sagebrush, and alfileria. Grasshoppers, crickets, and other insects are eaten by the squirrels, and 18 caterpillars from one stomach were recorded by Bailey. The squirrels have been reported to catch and kill young chickens and to devour their own kind found caught in traps.

*Economic status.*—Grinnell and Dixon consider this species second in economic importance in California to the California ground squirrel; they point out that these squirrels occur in great abundance in the grasslands and do serious damage to range grasses. Also, in some sections, they inhabit fields of alfalfa and grain—wheat, oats, and rye—and destroy a large proportion of the crops.

This species has in recent years been found to carry bubonic plague. Surveys made during the summer of 1934 in Modoc County, Calif., resulted in finding the disease in 5 percent of the squirrels shot or found dead in an area of 65,000 acres. In April 1935, plague was proved in 107 Oregon ground squirrels (7 percent of 1,492 squirrels shot) in Modoc County. A fatal case of human plague occurred at Lakeview, Oreg., in May 1934, probably contracted from a ground squirrel of this species (Meyer, 1936, p. 964).

#### COLUMBIAN GROUND SQUIRREL AND RELATED RACES

*General habits.*—The Columbian ground squirrel and related races (*Citellus columbianus* subsp.) (pl. 4) live in a wide variety of habitats, from the open prairies of eastern Washington to the mountain parks at an altitude of 7,000 or 8,000 feet. Apparently the animals prefer rough, rocky, half-forested hillsides, but in many places they are numerous in hay meadows, grainfields, stony pastures, and open pine flats. They live in colonies but are somewhat less gregarious than prairie dogs. They spend the greater part of the daylight hours gathering and consuming food from an area rather close about their burrows, seeking safety in their dens when danger appears, but if the food supply is limited near their dens, they often make somewhat extended trips in search of some favorite item.

These squirrels are rather noisy, and in a colony their alarm note—a clear, sharp *chirp*, repeated a number of times—is almost constantly heard from sunrise to sunset. In places where they are persecuted by man and also in wilderness areas remote from civilization they are usually shy and are difficult to approach closely. When given protection, however, as in some of the national parks, they become so tame that they will take food from the hand.

*Burrows and nests.*—The burrows of these squirrels are dug beneath logs, stumps, or boulders and descend at an angle of about 45°. Vernon Bailey (1918, p. 47) describes a summer den that he excavated near Piegan Pass, at 7,000 feet altitude in Glacier National Park, Mont., as follows:

The mound at the entrance of the burrow contained about 4 bushels of earth and stones brought from the burrow, and the lower part was packed and hard as though an accumulation of several years. There were two other openings

farther back from which no earth had been thrown and evidently they had been tunneled to the surface from below. The main shaft of the burrow was usually 3 or 4 inches in diameter, and back a couple of feet from the entrance, just before the burrow forked into two main shafts, was a roomy chamber where the squirrels could turn around and sit up comfortably, a sort of reception room. Near secondary forks were also two other chambers which may have served several purposes, such as convenience in storing earth brought out of the tunnels, or places of retreat from which to watch for enemies that might enter the burrow from either direction. Well back about 8 feet from the entrance and a foot below the surface of the ground was a large nest chamber about a foot in diameter nearly filled with old soft nest material. The nest was composed almost entirely of the soft flat leaves of the brown "glacier grass" (*Juncoides parviflorum*) which abundantly covers the mountain slopes. At the bottom it was damp and moldy, but from the bed in the center to the top it was dry and clean, and a few fresh, green blades had been brought in for food or nest material. It had evidently served as winter quarters for the old squirrel and as a nest for her young and was being prepared for the coming winter. From one side of the nest chamber the burrow led down to an older and deeper chamber of some previous year, containing at the bottom an old rotten nest half full of excrement. A tunnel ran from it back toward the main entrance and into the main tunnel near the middle, making an easy way of escape if an enemy should dig to the first nest. Back of the nest a small shaft led to the surface of the ground and another opened out at the end of the first main fork of the tunnel. These rear openings were half concealed in the grass and evidently were for use as avenues of escape in case the burrow should be entered by a weasel or dug out by bear or badger.

*Estivation and hibernation.*—This species spends from 7 to 8 months annually in a dormant condition. Those individuals living in the valleys and on the prairies become very fat by midsummer, and from July 15 to 30 a noticeable decrease in their numbers is observed as some of them enter estivation. In eastern Washington, in dry seasons by July 29 and in wet seasons by August 11, all have entered their dens for the long sleep (Shaw, 1925a, p. 75). These squirrels do not as a rule drink water, but depend upon succulent vegetation to supply needed moisture. Apparently the date of beginning estivation is determined chiefly by the ripening of the vegetation and consequent reduction of the moisture content in their food, and in part also by the accumulation of fat in the body.

At Osborn, Idaho, the last of the ground squirrels disappeared following a first frost on August 8 (1895). In the Bitterroot Valley, Mont., all had begun estivation by August 25 (1909). In the mountains, at higher altitudes, some of the animals remain out until the first week in October (Woodman Creek, west of Lo Lo, Oct. 7). A single individual was taken near Kalispell, Mont., on October 1 (1932).

At Pullman, Wash., the first squirrels came out of their hibernation dens on February 21 (1913), March 1 (1912), and March 8 (1911 and 1917). At Endicott and St. Johns, Wash., they first appeared from February 2 to 9 (1909). In the Bitterroot Valley, Mont., the first were seen on March 6 (1910), and March 25 (1912), and by March 31 they were out in full numbers.

The hibernation dens have been studied and described by W. T. Shaw (1925b, fig. 2, opp. p. 58), who states:

A hibernation den is frequently a part of an ordinary den shut or sealed off from the main den by having all connecting burrows very effectually plugged. It may, however, be quite remotely hidden away from the large summer den.

Of 50 hibernation cells measured, the average depth below the surface was found to be 2 feet 6 inches; the shallowest cell was 6

inches below the surface, the deepest 4 feet 11 inches. Occupied dens are sealed by the squirrels with a plug of earth 2 feet or more in length, tamped in. For most of the hibernation dens (except those on a side hill) drainage is provided to carry water away. In some cases an exit shaft leading toward the surface is provided. When ready to come out in the spring the animal digs its way to the surface, placing the soil removed in the bottom of the burrow, thus leaving no loose dirt at the entrance.

*Storage of food.*—Food supplies are stored in the hibernation dens to a limited extent. Regarding this habit, Shaw (1925b, fig. 11, opp. p. 79) writes as follows:

Very unexpected information has been found in connection with the matter of the food supply being stored for the winter. The nests of female and immature squirrels are almost without exception lacking in a store of food. The nests of the old males, on the other hand, very frequently, though not always, have a cache of some kind of food. Strange to say, in this stored supply they seem to prefer some wild seed or bulb to grain, and nests found in wheat fields are frequently stored with some wild seed. Furthermore, they usually use but the one kind of seed, or bulb, in a nest at a time, though several kinds of seeds and bulbs have been found in the various nests discovered. In this connection it is interesting to note that the old male squirrels appear a week to 10 days before the females and immature, often when the weather is bad and food scarce, hence the need of food. It is also of interest to note that the store, which is found in the mulch or bottom of the nest, seems not to be touched during the winter, as several interesting observations tend to show, but is reserved until the time of awakening in the spring.

*Breeding.*—The number of young in a litter varies from 2 to 5, rarely 7, averaging about 3.5. The gestation period, as determined by Shaw (1925d, p. 108) from animals kept in captivity under semi-natural conditions, is 24 days. The rutting season begins about March 15 to 20, and Shaw records capture of a wild adult at Pullman, Wash., on April 6, carrying 6 fully formed embryos. At Ford, Idaho, James Silver examined 25 females on April 10 that were carrying large embryos; on April 16, 13 females showed evidence of having recently borne young. Probably in the mountains most young are born early in May; at Nyack, Mont., however, a female was captured on June 24, 1895, carrying 3 embryos. The young are able to leave the nest in about 4 weeks after birth. At Pullman, young were first observed out of their dens between May 4 and 10.

*Food habits.*—The food of the Columbian ground squirrel comprises a great variety of vegetable substances and a small proportion of animal matter. A large part of the vegetable food consists of wild and cultivated grasses, herbs, and fruits, including the bulbs of camas, wild onion, and glacierlily (*Erythronium grandiflorum*); stems, leaves, and flowers of false-hellebore (*Veratrum*), buttercups, roses, dandelions, mule-ears (*Wyethia*), balsamroot (*Balsamorhiza*), camas (*Quamasia quamash*), lupine, and wild lettuce; currants, gooseberries, strawberries, and serviceberries (*Amelanchier*).

On cultivated lands the squirrels consume the stems and heads of clover, alfalfa, bluegrass, oats, rye, wheat, and barley; vines of potatoes, beans, and peas; lettuce, carrots, and probably other vegetables.

Grasshoppers, cicadas, and caterpillars are frequently eaten, and sometimes fish, if the habitat borders a lake.

*Economic status.*—Wherever it comes in contact with agriculture the large Columbian ground squirrel is destructive, particularly to

grain, clover, and pasture. When uncontrolled, the animals become numerous and may destroy practically entire crops in the area where they are living. Shaw (1925g, p. 264), writing of the section around Pullman, Wash., says:

During 7 successive years, 7,000 squirrels were trapped on 416 acres of the college farm, or 2.4 squirrels per acre each year. A successful wheat raiser near Steptoe, Wash., trapped 1,200 squirrels on 200 acres in 1 year, or 6 squirrels per acre.

Shaw's experiments showed that single animals kept in confinement under natural conditions in the course of a season destroyed, on an average,  $50\frac{1}{3}$  pounds of winter wheat.

This species has been shown to be in large part responsible for the dissemination of Rocky Mountain spotted fever. Birdseye (1912, p. 10), reporting on his studies in the Bitterroot Valley, Mont., says that it is undoubtedly the most important host of the two younger stages of the fever tick, and is almost always infested with ticks when occurring in suitable country. Plague infection was demonstrated in specimens of this species taken in Wallowa County, Oreg., in 1935 (Meyer, 1936, p. 964).

#### PARRY'S GROUND SQUIRREL AND RELATED RACES

*General habits.*—Richardson (1825, p. 319), writing of Parry's ground squirrel (*Citellus parryi parryi*) as observed on the Arctic coast between the mouth of the Mackenzie and Bathurst Inlet, says:

The gray Arctic marmot is common in stony barren tracks, but delights chiefly in sandy hillocks, amongst rocks, where it burrows, living in society.

Anderson (in Stefansson, 1913, p. 510), writing also of the Arctic coast in the same region, says that these squirrels were found at many points along the coast in sandy clay hills and were particularly abundant in sandy alluvial river bottoms. Along the Mackenzie River, below Fort Good Hope, E. A. Preble found the animals living in burrows in the clay banks, well above high-water mark. On the Barren Grounds near Cape Eskimo, Hudson Bay, he found them occupying gravelly ridges, either old shore lines, or deposits left in the process of glaciation, and around Artillery, Clinton-Colden, and Aylmer Lakes, Seton and Preble (Seton, 1911, p. 342) found them frequenting similar situations.

In McKinley Park, Alaska, O. J. Murie reported the subspecies *C. p. plesius* numerous in the valleys, on the slopes, and on the ridges. Some had dug their burrows among willows and in vegetation on the slopes, and others lived among rocks. A burrow dug out there was found to have two entrances and many ramifications; its greatest depth was 27 inches. In the Delta River region he found the squirrels inhabiting the river bars and the flats among the dwarf birches and willows, as well as on the hills where cover was scarce. In northern British Columbia, Preble found them in broad nearly level valleys clothed with shrubby vegetation, or on the gentle lower slopes of mountains, and seldom or never above timber line.

Richardson speaks of the alarm note of this species as "a kind of a whistle", and when the animal is in terror this note is said to resemble the sound of a watchman's rattle.

*Hibernation.*—R. M. Anderson (in Stefansson, 1913, p. 510) states that on the Arctic coast, most of these squirrels go into hibernation

the latter part of September, though a few remain out until the middle of October; and that they reappear in spring about the middle of April. At Collinson Point, however, on October 2, they were out in some numbers, and at Point Barrow individuals have been taken on October 15, November 10, and December 3. At Wiseman, on the south slope of the Endicott Range, two ground squirrels were seen by O. J. Murie on October 23 (1924).

At Cold Bay, the Alaska Peninsula race (*C. p. ablusus*) was active in some numbers as late as October 18 (1902) (Osgood, 1904, p. 32), and at Togiak, Alaska, a specimen was collected on March 10 (1897). At Chignik, Alaska, during the mild winter of 1911-12, the squirrels were seen occasionally throughout the winter and a specimen was captured on February 13. The small mountain form (*C. p. plesius*) was observed at Teslin Lake, Yukon, on October 3 and specimens were taken in the Tanana Hills, Alaska, on March 4.

*Breeding*.—Richardson (1825, p. 318) records taking a female that contained seven embryos at Point Lake, Mackenzie, on June 13. Judging from the size of two young individuals taken at Old Fort Good Hope, Mackenzie, it seems probable they were born about the middle of May. Edmund Heller recorded a female of *C. p. plesius* suckling young on June 10, and another carrying a single large embryo on June 11, at Telegraph Creek, British Columbia.

*Food habits*.—Richardson (1825, p. 319) reported the food of Parry's ground squirrels to be entirely of vegetable origin. He says:

In upwards of 50 individuals examined at various periods, no animal substance was detected in the pouches or stomachs. At Point Lake in lat. 65°, their pouches were observed about the middle of June to be filled with the berries of the *Arbutus alpina* and *Vaccinium vitis-idaea*, which were just then laid bare by the melting of the snowy covering, under which they had lain all winter. In the end of July, on the shores of the Arctic Sea, their pouches contained the seeds of a *Polygonum*, and in Five Hawser Bay in September, they were filled with the seeds of *astragali*.

At Aylmer Lake, Seton (1911, p. 237) obtained a ground squirrel with its cheek pouches full of mushrooms.

Anderson (in Stefansson, 1913, p. 510) states that along the Arctic coast, the squirrels fed mainly on the roots of various species of *Polygonum*.

The stomach of a specimen of *C. p. ablusus*, taken on Unimak Island, Alaska, May 8, 1925, and examined in the Biological Survey, contained the following materials: 21 caterpillars and lepidopterous pupae, 60 percent; 1 tipulid larva and 5 *Bibio* larvae, 4 percent; 2 beetles (*Cryobius* sp.); 1 ichneumonid and a spider, trace; 2 berries (*Vaccinium* sp.), 2 percent; a few leaves of *Empetrum nigrum* and other vegetable matter, 34 percent.

#### YUKON VALLEY GROUND SQUIRREL

*General habits*.—Osgood (1900, p. 31) describes the habits of the Yukon Valley ground squirrel (*Citellus osgoodi*) as follows:

From Fort Selkirk, near the limit of *Spermophilus plesius* in the interior, nearly to Circle, we saw no signs of ground squirrels of any kind. Just before reaching Circle, however, we began to see unmistakable signs of them and were soon attracted to a small colony by their clicking calls which reached our ears as we floated down in midstream. The call is executed in about the same time as that of *S. plesius*, but its pitch is much lower and its effect on the ear is

utterly different. It suggests the click of castanets. On going ashore we found their burrows and connecting paths scattered over quite an area on the hillside. The colony occupied the open hillside and a few ledges of loose rock, and even extended down into a thicket of alder and willow at the foot of the hill. The animals were very shy and became much excited at our approach. Their long tails were very noticeable in marked contrast to the short ones of *S. plesius*, which we had been accustomed to seeing.

Writing of his second trip down the Yukon, Osgood (1909, p. 22) writes of these ground squirrels as follows:

Many of their burrows are made in the sandy banks of the river, often only 3 or 4 feet above high-water mark, and usually open under the overhanging turfs of the bank or among the exposed roots of trees and shrubs. Higher up they are variously situated on the hillsides, where the little boreal sagebrush (*Artemisia frigida*) flourishes. As a rule, however, the hillside burrows are not in exposed places, but are more or less sheltered by small bushes near the edge of the timber. The animals were rather quiet and seldom gave their clicking cry except when alarmed. They fought viciously when being taken from traps, often lunging at us with mouth open and claws spread. Several were seen at the water's edge, and tracks were abundant on the damp sand, but whether or not they drink there was not ascertained. Nearly all the females taken had the mammae distended with milk. Apparently most of the young were too small to leave the burrows. At one place 5 little squirrels all of a size and evidently from the same mother were caught in rapid succession. Of these, 4 were normal in color and the fifth was in the black phase. Among adults the black phase was found in about the same proportion.

#### STRIPED GROUND SQUIRRELS

*General habits.*—The striped ground squirrels (*Citellus tridecemlineatus* subsp.) dwell chiefly on dry grassy prairies and to a less extent in sandy river bottoms and the brushy borders of timber tracts. They are gregarious only to a slight extent, and not at all sociable, individuals usually living a more or less solitary life and often digging a number of burrows, some of which are shallow and are used for temporary shelter and others of more elaborate construction for more permanent use. These latter are ordinarily in the hard soil of upland pastures or meadows and are said always to have two entrances. They descend steeply for a short distance, then extend horizontally. They may be as much as 20 feet in length and from 4 to 46 inches in depth. Usually there is no earth piled around the entrance, the rim of the burrow being level with the surface and thus quite inconspicuous. Frequently the burrows are plugged with earth by the squirrels after entering, especially during hibernation. Sometimes abandoned burrows of other rodents are used, including those of prairie dogs, kangaroo rats, and pocket gophers.

Nests of dry grass of a spherical shape are found usually in the longer permanent burrows, at depths varying from 3 to 29 inches (Johnson, G. E., 1917, p. 264). The nests are used in spring to house the young, in summer for storage of food supplies, and in winter for hibernating quarters.

Breeding activities are at their height during April, and the young, numbering from 5 to 13 (commonly 6 to 10), are brought forth ordinarily in May or early in June. The gestation period is given by Wade (1927, p. 271) as between 27 and 28 days.

The note of this species is described by Bailey as "a rapid bird-like trill or trembling whistle—a long drawn-out *chur-r-r-r-r* in a high key."

*Hibernation.*—The date of entering on the winter sleep varies with season and locality. At Lincoln, Nebr., Wade (1930, p. 169) reported that in 1927 nearly all had disappeared by the first week of September, while in 1926 they remained out much later, small numbers being seen until October 17, when the last one was noted. In Colorado, according to Burnett (1914, p. 6), the latest date recorded is November 9, and the earliest date in spring, March 23. Other late fall dates are: October 30 (Illinois), November 3 (Springerville, Ariz.), and November 23 (Oklahoma).

Wade (1927, p. 270) states that in the vicinity of Lincoln, Nebr., these squirrels emerge from hibernation between the middle of March and the first of April; in 1926 the first were seen on March 17. Near Minneapolis, Minn., they were reported to appear 1 year on March 17 and 2 years on April 5. In southern Manitoba, according to Seton, they may come out as early as March 27, or in backward seasons as late as April 20. Johnson (Johnson, Foster, and Coco, 1933, p. 266) states that in west-central Kansas the males appear in numbers above ground usually about the middle of March and the females about the last of March or first of April.

*Food habits.*—The striped ground squirrels feed on a variety of wild plants and seeds, in addition to cultivated grains, and are especially fond of grasshoppers and other insects. Bailey (1893, p. 39) has given an extended account of the food of this species, in which he shows that more than half the contents of 80 stomachs examined consisted of insects, including grasshoppers, crickets, caterpillars, beetles, ants, and insects' eggs. The vegetable matter comprised oats, wheat, cactus fruit, nightshade berries, roots, herbage, and seeds of goosefoot (*Chenopodium*), knotweed (*Polygonum*), and sunflower (*Helianthus*). Eleven cheek pouches of this species examined contained only seeds, including wheat, oats, millet, deervetch (*Lotus*), and seeds of porcupine grass (*Stipa spartea*), sunflower, gromwell (*Lithospermum*), bristlegrass (*Setaria*), *Panicum*, ragweed (*Ambrosia*), and black locust (*Robinia*). To the list may be added cotton, clover, and flax seed, wild beans, and seeds of dandelion, vetch, ricegrass (*Oryzopsis*), gumweed (*Grindelia*), and the buffalo-bur (*Solanum rostratum*). Morris M. Green (1925, p. 176) records the capture of a striped ground squirrel that had its cheek pouches bulging with 196 large seed pods of the sleepy catchfly (*Silene antirrhina*).

Much of the dry food gathered by these squirrels is stored in their burrows; concerning this habit, Kennicott (1857, p. 77) writes:

Many of our farmers suppose that this animal feeds, in winter, upon stores of provisions laid up in its hole for that season; for, though it spends the winter in a state of profound torpor, it collects food in its burrow. This is done in spring and summer, as well as in autumn. Considerable stores of grain, seeds, roots, &c., are found thus collected, in large sidechambers excavated for their reception in the burrow. Corn, wheat, and oats are stored up, when taken from the newly-planted fields in spring, with buckwheat and winter wheat later in the season, as well as heads of grain taken from the edges of the fields in harvest time. I have seen more than a quart of crab-apples taken from the burrow of one which had carried them several rods from a tree. George and Frank Kennicott inform me that they observed one, the burrow of which was near a lone burr-oak, on the prairie, to carry great quantities of acorns into his hole; and another was killed by them, the cheek-pouches of which were crammed with the dry ovaries of a prairie plant, the seeds of which were exceedingly minute. From this, it would appear that the

striped spermophile at all seasons carries portable articles of food to its burrow to be eaten. He certainly takes no food from the time he first becomes torpid, in autumn, until he again becomes active late in the following spring.

Johnson records a burrow of this species in which the nest cavity was entirely filled with unshelled oat kernels, estimated to number about 23,000, and another burrow that contained 2,000 or 3,000 wheat kernels.

This species shows a rather decided taste for flesh food, and it has several times been reported to capture and kill mice (Bailey, V., 1893, p. 38), and small chickens (Bailey, B., 1923, p. 129; Green, 1925, p. 175), and even to feed on the bodies of its own kind.

*Economic status.*—The most serious charge against these ground squirrels is that they dig up and destroy newly planted corn. Where the squirrels are abundant, this habit may result in serious damage to a crop but ordinarily the depredations are confined to a few rows on the edge of a field. Peas, beans, cucumbers, squashes, beets, strawberries, and other garden crops are sometimes damaged, and fields of wheat or oats are occasionally drawn upon for supplies to be stored in the burrows.

Against these destructive tendencies must be placed the evident fondness of the squirrels for grasshoppers, cutworms, webworms, and other injurious insects, the destruction of which undoubtedly exercises an important check on the ravages of the pests. Wherever the squirrels occur on extensive grasslands they are distinctly beneficial.

#### MEXICAN GROUND SQUIRRELS

*General habits.*—The Mexican ground squirrels (*Citellus mexicanus* subsp.) inhabit sandy plains where there is a growth of cactus or mesquite, and both in Mexico and the United States they range out into cultivated fields of corn or other grain. Their burrows, usually situated at the base of mesquite or other bushes or on the edge of a bunch of cactus, descend nearly perpendicularly for a foot or more, then slope down at an angle still deeper.

Apparently these squirrels do not hibernate, but they have the habit of plugging the entrance to their burrows after going in, and during cold weather they may remain under ground for considerable periods. They are shy and usually silent, but Nelson states that they have a shrill, whistling note of alarm.

*Food habits.*—Bailey (1931, p. 115) reports this species feeding in about equal proportions on seeds and insects. Mesquite beans and seeds of *Acacia* are said to be favorite foods and doubtless many other seeds are eaten. At Langtry, Tex., Gaut found the squirrels feeding on the purple blossoms of a groundcherry (*Physalis lobata*). They often range into cultivated fields and do considerable damage in spring by digging up corn, melons, beans, and sweetpotatoes, and later by eating ripening grain.

#### SPOTTED GROUND SQUIRRELS

*General habits.*—The spotted ground squirrels (*Citellus spilosoma* subsp.) (pl. 5) seem to prefer dry, sandy soil for their habitation. They live in drifted sand along river flats, in grassy parks, in open pine forests, and to a less extent on rocky mesas. Their burrows



APACHE SPOTTED GROUND SQUIRREL (CITELLUS SPILOSOMA CANESCENS), TWO COLOR PHASES.



are usually under a bush, in a weed patch, or under an overhanging rock. D. E. Lantz dug out a burrow at Hugo, Colo., that had three entrances and was about 12 feet in length, though nowhere more than 18 inches below the surface. It terminated in a small, rounded chamber in which was a slight nest of grass. In some localities the squirrels often appropriate the burrows of kangaroo rats or other rodents. Like most of the ground squirrels, they are strictly diurnal, but are rarely seen abroad during the heat of midday. They are shy and retiring and of gentle disposition, and when captured alive make attractive pets. Vernon Bailey describes their call note as "one long, bubbling, birdlike whistle."

These little squirrels do not wander far from their burrows, and in running their movements somewhat resemble those of a lizard; the body is more or less flattened, the tail is held close to the ground, and the squirrel proceeds by short runs with frequent stops.

*Hibernation.*—Hibernation in this species is apparently not complete, at least in the more southern parts of its range, but during severe winter weather the animals usually remain within their burrows. Specimens have been taken near Tucson, Ariz., from January 27 on through February and March; at El Paso, Tex., February 9, 20, and 21; in Lake Valley, N. Mex., November 13; at Deming, N. Mex., December 4 and 6; and at Chihuahua, Mexico, December 25.

*Food habits.*—The food of these ground squirrels is largely green vegetation and seeds. The following items have been identified in their stomachs: Cactus pulp, mesquite beans, seeds of saltbush (*Atriplex*), sandbur (*Cenchrus*), sunflower, gourd, and iris; grasshoppers and beetles. Living mostly in uninhabited regions these squirrels are of little economic importance. They undoubtedly consume considerable grass and in cultivated areas are sometimes troublesome in digging up planted seeds.

#### PEROTE GROUND SQUIRREL

*General habits.*—Little is known of the habits of the Perote ground squirrel (*Citellus perotensis*). Nelson reported that it lives in the plains, about the borders of wheatfields and cornfields.

#### FRANKLIN'S GROUND SQUIRREL

*General habits.*—Franklin's ground squirrel (*Citellus franklinii*) (pl. 6) or the "gray gopher," as it is frequently called, inhabits prairies, bushy pastures, grainfields and hayfields, open groves of timber, and partly dry marshes. Kennicott (1857, p. 79), writing of its habits in Illinois, says:

It is observed to inhabit the thickets of low bushes, and the edges of the timber, more than the other [*C. tridecemlineatus*], but does not occur in the woods. It is fond of digging long burrows in the banks of ditches, and several times I have seen it living in steep river banks, as well as under small wooden culverts in roads. It is not so shy as the striped spermophile, and takes up its residence quite near dwellings.

Wood (1910, p. 528), writing from Illinois half a century later, says of these squirrels:

At present a necessary condition for their habitation seems to be the presence of some shelter, such as may be furnished by tall grass, or a field of clover, alfalfa, or grain. Others have noticed that when the crop on such a field is cut

the gophers leave, at least for a while, and my own observations coincide with theirs, though I have known the gophers to return to the same spot after the second crop of alfalfa had started. They avoid closely cropped pastures, well-kept cemeteries, lawns, and similar places where the striped gopher is especially abundant, yet even in such localities I have found them congregated under a heap of compost. In fact such a shelter seems to have special attractions for them, as noted by Bailey. . . .

The species is decidedly gregarious, nearly always being found in colonies. As their burrows each have several openings and these are conspicuously marked by the dirt thrown out, a colony becomes a great nuisance in a hay or grain field. The conspicuousness of these burrows and of the animals themselves has aroused the animosity of the farmers and hastened the destruction of the gophers.

Kennicott (1857, p. 80) describes their notes as "a remarkably clear whistle twitter, more musical than the voice of any other mammal I ever listened to, and as clear as that of a bird."

*Hibernation.*—Franklin's ground squirrel has been known to store up in September as much as half a peck of oats in a burrow under a shock. The animals, however, become excessively fat in fall and all retire to their burrows in October, where they remain in hibernation until April. Bailey (1893, p. 52) gives dates of their appearance at Bathgate, N. Dak., as April 3 (1889) and April 21 (1890). Kennicott states that they have been found hibernating under piles of rails and in corn shocks, and in two instances in a hay stack. Remington Kellogg states that he has found the animals torpid in a burrow about 3 feet underground.

*Breeding.*—The young, 5 to 10 in a litter, are born in May or June; by the last of July, in North Dakota, they are out of their burrows foraging for food. Adults carrying embryos were taken at Elk River, Minn., on May 7, and at Carberry, Manitoba, on June 15.

*Food habits.*—The vegetable food of this ground squirrel comprises about two-thirds of the total and includes clover, timothy, junegrass; leaves of plantain, mustard, and probably other wild plants; wheat, oats, barley, newly planted corn; seeds of needlegrass (*Stipa*), cockle-burs, and basswood; strawberries and nightshade berries. Animal matter, found in 29 stomachs examined in the Biological Survey, consisted of beetles and their larvae, caterpillars, grasshoppers, crickets, ants, eggs of insects, and feathers of a small bird (Bailey, 1893, p. 55). Individuals of this species have been known to kill and eat wild mice and a young rabbit, to rob a meadowlark's nest, to kill a wood pewee, to capture small chickens, and to eat hens' eggs.

*Economic status.*—In localities where these squirrels are abundant, they may do considerable damage to crops by digging up newly planted corn and in the fall by burrowing under corn shocks. They sometimes invade vegetable gardens and destroy peas and cabbage, and in grainfields they destroy considerable grain in the vicinity of their burrows.

### ROCK SQUIRRELS

*General habits.*—The several races of the rock squirrels (*Citellus variegatus* subsp.) (pls. 7 and 8) have habits similar to other ground squirrels; all show such a decided preference for inhabiting rocky canyons and rocky mountain sides that their name "rock squirrel" seems quite appropriate. In central Mexico, the typical race (*C. v. variegatus*) is reported by Nelson and Goldman to live on rocky hill-



FRANKLIN'S GROUND SQUIRREL (*CITELLUS FRANKLINII*).

A. H. COOK & CO. Lith. Baltimore



sides, along stone walls or irrigation ditches, and in cactus or mescal hedges, often ranging out into cultivated fields. Their burrows are dug usually under a large boulder or sometimes in thickets. Although typical ground squirrels, they climb trees readily in search of food, and occasionally make their homes in hollow trees as high as 15 or 20 feet from the ground (Bailey, 1905, p. 85). They often climb to the tops of juniper trees to gather the berries, and into mesquite trees to eat the green buds or the beans.

The rock squirrels are known to store food extensively for use in winter, and it seems probable that over the greater part of their range they remain more or less active throughout the year. Whether they ever actually hibernate is not known. During the colder parts of the year they are seen out of their dens only on mild, sunny days. Their food supplies, consisting chiefly of acorns, walnuts, and the seeds of peaches, plums, and apricots, are stored in earth burrows, in cavities in cliffs or under boulders, and in hollow trees.

The voice of the rock squirrel is described as "a loud, shrill whistle—a single note repeated at irregular intervals" (V. Bailey, ms.).

*Food habits.*—The food of the rock squirrels comprises a long list of vegetable materials and includes also grasshoppers, crickets, caterpillars, and other insects. Nuts, including acorns, walnuts (*Juglans rupestris*), and pine nuts (*Pinus edulis*) probably furnish a large part of the yearly food. Other seeds that have been found in the cheek pouches or stomachs of these squirrels are those of mesquite, cactus, saltbush (*Atriplex*), wild gourd, wild cherries, muskmelon, watermelon, fragrant sumac (*Rhus aromatica*), Nevada jointfir (*Ephedra nevadensis*), serviceberry (*Amelanchier*), spurge (*Euphorbia*), and marbleseed (*Onosmodium occidentale*), and berries of the wax currant (*Ribes cereum*). The rock squirrels are reported to feed on wild figs, cactus fruit, blossoms of the mescalbean (*Sophora secundiflora*), and the flowers and tender tips of the agave.

A specimen of Say's rock squirrel (*C. v. grammurus*) taken in New Mexico had its pouches stuffed with the berries of the cherrystone juniper (*Juniperus monosperma*); one taken in Texas had filled its pouches with the berries of the alligator juniper (*Juniperus pachyphloea*). In Colorado, according to W. L. Burnett (1918, p. 23), the food of rock squirrels of this subspecies "consists of seeds of various kinds, apples, cherries, apricots, chokecherries, blackberries, squash, and melons. They also eat garden peas, grains of all kinds, and feed to some extent on the seed pods of the Yucca and Indian breadroot (*Psoralea*)."

*Economic status.*—The rock squirrels, wherever they come in contact with agricultural operations, are considered a serious pest. They are known to carry off whole ears of corn and to damage all kinds of grain. Fruit trees, including peaches, pears, plums, and apricots, are visited and the fruit carried off to be eaten or the seeds stored.

#### CALIFORNIA GROUND SQUIRREL AND RELATED RACES

*General habits.*—Grinnell and Dixon (1918, p. 606) describe the habitat of the California ground squirrel (*Citellus beecheyi beecheyi*) (pl. 8) as follows:

Its preferences as to local conditions are not closely limited, except that it avoids dense chaparral and thick woods. It frequents pasture lands, grain

fields, orchards, sparsely tree-covered slopes, small mountain meadows, rock outcrops on the tops of ridges, and even granite talus slopes. It is always most abundant, however, in the open situations, and its decided preferences are such that it thickly populates much of the best farming and grazing lands in the State, to the great reduction of their producing value from the human standpoint.

Although a true ground squirrel, this species is able to climb trees with ease and the animals are often seen in oaks or other nut-bearing trees and in fruit trees.

*Burrows and nests.*—Writing of the animals' burrows, Grinnell and Dixon (1918, p. 606) say:

In shallow adobe or clayey soil, underlain by broken rock, the burrows were found to be short, of small diameter, and not reaching to any considerable depth. Those in alluvial or sandy soil were found to be of large diameter, of greater extent, and to reach to much greater depths.

The most conspicuous signs of activity on the part of ground squirrels in any locality are the large mounds of earth that have accumulated in the course of excavating the burrows. This earth is commonly thrown out in a fan-shaped pile directly in front of, and to the sides of the main entrance to the burrow. These mounds of earth are often 3 or 4 feet in diameter and from 6 to 10 inches above the general level.

Seven burrows of this species were excavated by Grinnell and Dixon, who report that the shortest occupied burrow was 5 feet in length and the longest 138 feet, the average length being 35.2 feet. These burrows varied in depth from 18 to 66 inches below the surface. Three types of burrows are described by them (1918, p. 612):

The male squirrels were usually found in short, shallow, simple burrows at the outskirts of the "colony." . . . It is believed that at least during the breeding season the male squirrels live altogether by themselves in their own individual burrows.

The second type was illustrated by a single burrow, 22 feet in length and 30 inches deep, containing a female and four young with eyes still unopened. This burrow was much more complicated than those occupied by the males.

The third type of burrow might well be called a "colonial burrow", as it is used by both sexes and also by the young after these leave the nest burrow and begin to forage for themselves. Colonial burrows are used largely as "safety zones." They afford convenient places for the squirrels to duck into when danger unexpectedly appears. These burrows are often from 100 to 200 feet in length and form a communicating system of underground runways connecting from six to twenty entrances or surface openings. . . .

Each burrow occupied by a single squirrel was found to contain at least one well-made nest. In some cases there were two, one obviously older than the other. In the colonial burrow that was dug out, three nests were found, of which two were new. The nests were always placed well back in the burrows, where they would have maximum protection from digging enemies such as coyotes and badgers. The cavities in which the nests were placed were short globular chambers and were usually situated slightly above and to one side of the main run, so that the drainage was away from rather than into the nest. . . .

All of the nests found were of similar composition and construction. Finely shredded dry grass blades and roots, and fine stems of foxtail and needlegrass, formed the bulk of the constituent material. The nests were spherical in shape and deeply cupped. The walls were from two to two and one-half inches thick (1918, p. 615).

*Breeding.*—The principal breeding season in the lowlands extends from February to the middle of April; at higher altitudes it occurs later, even into June. The litters number from 4 to 11, averaging 7.5.



BLACK-BACKED ROCK SQUIRREL (*CITELLUS VARIEGATUS BUCKLEYI*), UPPER.  
MEXICAN ROCK SQUIRREL (*C. VARIEGATUS VARIEGATUS*), LOWER.

A. Horn & Co. Lith. Baltimore.



In the lowlands the majority are probably born the last of March, and by the last of April the first-born are beginning to appear above ground, playing about the mouths of the burrows (1918, p. 620).

*Hibernation.*—In these ground squirrels hibernation is not universal, and it is not yet known to what extent the animals become dormant. Over the greater part of their range some individuals may be seen abroad most of the year. There are specimens in the Biological Survey collection taken at Los Banos, Calif., on January 3 and 4 and at Modesto on December 13. Grinnell and Dixon (1918, pp. 631, 632) present a table showing that large numbers of the animals were taken in January in Contra Costa County, the great majority of which were young adults. In their opinion: "It is probable that the full old-adult population is not abroad aboveground until the last of February." These writers cite an instance of a squirrel observed closely for a number of years in Pasadena that did not estivate until its second year.

Then and during each succeeding year of its life it estivated regularly, becoming very fat and retiring to its burrow during the last week in August. It emerged lean and hungry, with marked regularity, about the twenty-second of each following February. When removed from the burrow at intervals during this period, the squirrel was found to be in a torpid state, with respiration not perceptible.

It seems probable, therefore, in view of this single instance, that a certain proportion of adults of this species living in the lowlands regularly hibernate. According to Grinnell and Storer (1924, p. 164)—

Those individuals which live above the snow line in the mountains hibernate for considerable periods during the winter months. In Yosemite Valley, ground squirrels in 1920 were first seen out of their burrows about the middle of March, according to Mr. Forest S. Townsley. One exceptional individual was seen out by one of us, on the Big Oak Flat Road below Gentrys, on December 28, 1914.

*Storage of food.*—These ground squirrels regularly carry off in their cheek pouches various seeds and heads of grain, as well as acorns and olives, and store them in their burrows. Writing of this habit, Grinnell and Dixon (1918, p. 628) say:

In Strawberry Canyon on the University campus, in April, the squirrels were harvesting foxtail and alfalfa on sunny southern exposures where the plants had matured early. Later in the season, during late June and early July, these same squirrels with their families of half-grown young were found to have moved down the hillsides, some 150 yards, to the moister, shady ground near the creek bed where the foxtail was still green, and here they were busily gathering the foxtail heads just ripening on July 6. . . .

In digging out a colonial burrow near Bakersfield, Kern County, on May 3, 1918, a storehouse was uncovered. This consisted of a cavity or pocket off the main run, which measured five and a half by eight inches in two diameters and was eighteen inches beneath the surface of the ground. The stored food consisted of a double handful of nearly dry heads of foxtail grass carefully packed in dry sand. A few alfalfa seeds were also included with the foxtail (op. cit. p. 629).

Merriam (1910, p. 5) writes of the storing habit as follows:

In Modesto in May 1909, Piper found stores of alfalfa seeds packed in cavities and well mixed with dry sand. In December of the same year he examined a number of stores of grain unearthed by a farmer while scraping and leveling his land. Each of these caches consisted of from a pint to a quart of oats stored in cavities and packed in dry sand.

Hollister was told by farmers at Aptos that a burrow that had been opened in a wheatfield was found to contain 3 pecks of shelled wheat.

*Food habits.*—The California ground squirrel feeds on a great variety of seeds, nuts, fruits, and green herbage. Merriam (1910, p. 4) states—

Acorns are a favorite food and where obtainable are gathered and stored in large quantities. The same is true of manroot (*Echinocystis fabacea*), the seeds of which are eagerly eaten, according to Piper, from the time they begin to form until fully ripe. At Modesto the squirrels were eating them as early as the middle of May and as late as the middle of December. Other favorite seeds are those of elderberry (*Sambucus*), jimson weed (*Datura*), wild nightshade (*Solanum*), turkey mullein (*Eremocarpus*), tarweed (*Madia*), and numerous grasses. Of cultivated nuts, almonds and walnuts are preferred; of other crops, apples, prunes, peaches, apricots, figs, olives, certain garden vegetables, the seeds of cantaloupes, watermelons, and citron melons, and all the grains are eaten wherever they are to be had, and green alfalfa and clover are sometimes taken. In November—sometimes earlier, according to the date on which the early rains begin—tender green vegetation becomes abundant, and the ground squirrels turn their attention to it. At this season their chief food consists of green stuff, mainly young wild oats and filaree, the latter a small member of the geranium family widely distributed in California and valued as a forage plant. In several localities in March the cheek pouches of animals examined by Piper were filled with the yet green seeds of filaree. In June the pouches are often filled with alfalfa leaves and flowers. In southern California the squirrels are fond of the fruit of the prickly pear (*Opuntia*).

Grinnell and Dixon (1918, p. 628) say that on wild land, alfalfa, foxtail, and bur-clover are perhaps the three forage plants that are eaten to a greater extent than any others.

The same authors (p. 626) mention a ground squirrel taken at Cisco in October that was carrying in its pouches 92 seeds of the green manzanita (*Arctostaphylos patula*) and another taken in Mariposa County that had dug up and was carrying in its pouches 12 bulbs of a species of wild-hyacinth (*Brodiaea hyacinthina*).

*Economic status.*—It may be seen from statements in the life history of this species that the California ground squirrel is capable of great injury to agriculture. In California, where it is considered to be the most important of the rodent pests, large sums of money are expended in efforts to control its depredations. In addition to the damage inflicted on crops of grain, forage, fruits, and nuts, the animals are reported to destroy young chickens.

In recent years this species has been found to be a carrier of both bubonic plague and tularemia. Plague appeared in California in 1900 and shortly thereafter it was found to be present in these ground squirrels. Dr. W. H. Kellogg (1935, p. 856), writing of the plague in California, said:

Infected squirrels [*Citellus beecheyi*] were found in 1908, and plague has been enzootic among the squirrels of California ever since. At that time an acute and very severe epizootic ensued, the number of plague-infected squirrels picked up in that county [Contra Costa] being over 1,700 during the few years following 1908. This epizootic extended in the neighboring counties of the Bay area and it was accompanied by a human epidemic in San Francisco and Oakland, the number of cases between May 1907 and June 30, 1908, when the last case of this second epidemic of human plague occurred, being 160 and the number of deaths 77.

Eradicative measures were carried on jointly by the Public Health Service and the State Health Department from 1908 to 1912, covering



*Nest of the squirrel.*

DOUGLAS'S GROUND SQUIRREL (*CITELLUS BEECHEYI DOUGLASII*), LEFT.  
SAY'S ROCK SQUIRREL (*C. VARIEGATUS GRAMMURUS*), RIGHT.



most of California and parts of adjacent States, and at the end of that campaign it was thought that danger of further spread of the plague had been removed. In the spring of 1934, however, fresh outbreaks of plague were discovered in Kern and Tulare Counties, and as a result of exterminative measures carried on in these counties from March to July, 5,973 squirrels were shot and 2,853 found dead, and of those sent to the laboratory, 118 were reported to be infected. The number of plague foci located was 41 over an area of approximately 896 square miles.

Tularemia was discovered in the California ground squirrel by Surgeon George W. McCoy in 1910 (1911, p. 53) while searching for plague in this rodent. According to Francis (1937, p. 106), however, human cases of tularemia have not as yet been traced to this animal.

### DOUGLAS'S GROUND SQUIRREL

*General habits.*—The habits of Douglas's ground squirrel (*Citellus beecheyi douglasii*) (pl. 8) in California are described by Grinnell and Dixon (1918, p. 646) as follows:

The local or habitat preference of this species is more exclusively for hilly country than in the case of the California ground squirrel. It is true that the Douglas exists out on the floor of the Sacramento Valley nearly to the lands annually flooded along the river; but it occurs there interruptedly, in far separated "colonies", and never anywhere are the great numbers reached that characterize *beecheyi* in the San Joaquin Valley. The preferred haunts of *douglasii* are the openings or glades on hillsides, beneath scattered oaks or pines, or else the open tracts along stream courses, not, however, quite down to the water's edge. The edges of the smaller valleys between the coast ranges are well populated, but the open floors of these valleys are not often invaded very far or in any considerable numbers. Dense chaparral and thick woods are avoided altogether. . . . Steep banks seem to be chosen for burrowing into, whenever available. Many burrows open under rocks, bushes, and tree roots. On open, level ground, with no protective shelter at hand, the mouths of the burrows are marked by good-sized mounds, showing the presence of an extensive system below ground. As far as we know, no one has yet made a complete excavation of the burrow system of this species.

Douglas's squirrel is reported to climb trees more frequently than the other members of the *beecheyi* group, and there are instances of individuals having been seen as high as 30 to 60 feet above the ground.

The alarm call of this species, according to Vernon Bailey, is—

a series of rasping squeaks with a rising inflection, somewhat like the cry of *Ochotona*. It is neither a whistle nor a chipper, but sounds like an attempted bark with something loose in the animal's throat.

Merriam mentions an individual that uttered "a shrill whistle of surprising loudness and penetration, suggesting the alarm note of the marmots."

Hibernation apparently is more prevalent in this subspecies than in any other races of *beecheyi*; at high altitudes the animals are reported to disappear completely for a period of 6 to 8 weeks in mid-winter. In the Sacramento Valley, at Chico and St. John, however, they were found out of their burrows on sunny days in winter and 6 specimens were taken there on January 4 and 6, 1906.

The young are brought forth during May in the lowlands, probably later in the mountains. Two specimens taken at Lower Lake, Calif., April 23, contained, respectively, five and six embryos; one

taken at Sherwood, Calif., May 5, contained seven embryos; one from Eel River, May 18, contained five; and one from Chico, May 20, contained five, nearly ready for birth.

*Food habits.*—The food of this ground squirrel consists largely of the seeds and fruits of a variety of wild plants, with the addition of cultivated grain and some insects (grasshoppers). The plant food recorded by the field collectors of the Biological Survey as found in the cheek pouches of these squirrels is as follows: Acorns, chinquapins, nuts of the California buckeye (*Aesculus californica*) and the California-laurel (*Umbellularia californica*), maple seeds, berries of skunkbush (*Rhus trilobata*), camas bulbs, seeds of California bur-clover (*Medicago hispida*), alfileria, and bitterbrush (*Purshia tridentata*), wild oats, and wheat. Grinnell and Dixon (1918, p. 648) list the following items found in cheek pouches of this species; 29 seeds of a wild lupine (*Lupinus micranthus*); 12 seeds of milkthistle (*Silybum marianum*); 219 grains of barley and one head of buck-horn plantain (*Plantago lanceolata*); 121 seeds of bur-clover (*Medicago hispida*); 181 seeds of California brome (*Bromus carinatus*) and a piece of an acorn; 29 seeds of Malta star-thistle (*Centaurea melitensis*) and 30 seeds of bur-clover; 14 whole fruits and 103 separate seeds of the common manzanita (*Arctostaphylos manzanita*).

*Economic status.*—Douglas's squirrel apparently is less prolific and never reaches the extreme abundance of the subspecies *beecheyi* and *fisheri*. Locally, however, the animals prove destructive to crops of wheat and barley and to the almond crop; Grinnell and Dixon (1918, p. 648) state that the squirrels have been known to invade apricot orchards, where they climb the trees and take out the apricot pits, discarding the fruit pulp.

#### RING-TAILED AND GOLDMAN'S GROUND SQUIRRELS

*General habits.*—In their notes on Biological Survey field work, Nelson and Goldman write of the habits of the ring-tailed and Goldman's ground squirrels (*Citellus annulatus* subsp.) (pl. 9) as observed in Colima, Mexico, as follows:

On the flat country about Armeria they are excessively common and in this locality one could have shot 20 in a morning. As a rule they are not shy although many will rush into their burrows at first glimpse of an intruder. We found their burrows on hillsides, among the rocks; and again in the sandy flats, along walls and hedges bordering cultivated fields; they are equally at home in the silent and gloomy shade of the densest groves of oil palms, with a burrow under a mass of fallen palm fronds or sheltered by the thorny growth of mesquite and acacia. Again their burrows are found under a cactus whose spreading branches give safe shelter on more open ground. The nuts of the oil palm, mesquite beans, cactus seeds and the fleshy fronds of the pear-leaved cactus, wild figs, moho nuts, and a variety of other seeds and fruits make up their varied bill of fare. In going silently along the trails leading through the dense palm groves and thickets of other trees, where the "tezmo" lives, they may be seen gliding silently from log to log or from one bunch of brush or similar shelter to another, now stopping a moment to dig for a seed or sitting up on their haunches to eat some morsel and then on again. They are often seen 10 or 12 feet up on the trunk of a small tree—sometimes out on the ends of branches after mesquite beans, cactus leaves, or other fruit—and when surprised they frequently run up a tree a few feet, take a hasty look at the intruder, then around the tree, down the other side and away in a direct line, so that before one knows it he may see his expected prey whisk into a brush pile or hole many yards away. Often they will crouch close to the ground and lie very still in the bushes so that they are only seen by accident, while others will



RING-TAILED GROUND SQUIRREL (CITELLUS ANNULATUS ANNULATUS).



steal softly away to some sheltering hole and thence utter short, shrill, whistling or chirping notes at short intervals. This is the only note we have heard them give. When their curiosity is aroused they will draw near, stopping to stand up on their hind feet, sometimes stretching the body up so that the tail is used to help support the body as on a tripod. At the first alarm they scurry away into the first shelter. They carry their tails in a curve quite squirrel-like in character and their motions are more light and agile than those of most spermophiles.

#### LESSER TROPICAL GROUND SQUIRREL

*General habits.*—The habits of the lesser tropical ground squirrel (*Citellus adocetus*) are described in the field notes of Nelson and Goldman as follows:

They live among rocks along canyon sides, about stone walls and corrals near ranches, and sometimes their burrows are located in open ground at the base of a tree or bush. They are seen running about at all hours of the day, but are most active from 9 to 11 in the morning. Near ranch houses they become quite tame and often approach to within a few feet of the doors after scraps of food thrown out by the people. In the fields and scattered woods where they occur they are rather shy and retreat to their holes at the first sight of a person or other cause of alarm.

They were abundant about the ranch near La Huacana [Michoacan] and especially numerous along the stone walls bordering the trail near the ranch of Agua Blanca and in the old lava beds extending away from the south base of the volcano of Jorullo. We left Agua Blanca early in the morning with the sun just becoming warm, and dozens of these little animals were seen scampering along the trail ahead of us, sometimes playfully pursuing one another or sitting up to look about. As we drew near they ran to the stone walls and either sat on the top or took refuge in the crevices and with heads projecting from the holes watched us pass. Now and then one scurried away to a hole under a stone or at the foot of a tree or bush. Their habits here were remarkably like those of *Citellus annulatus* along the stone-walled roads near the city of Colima. The present species has a sharp chirping call note. At the ranch near La Huacana they were living mainly in holes under rocks or bushes, but some also in stone walls. Wherever they are located along roads they have become accustomed to people and are less shy than in more unfrequented places.

#### ANTELOPE GROUND SQUIRRELS

*General habits.*—The antelope ground squirrels (subgenus *Ammospermophilus*) (pl. 10) live chiefly in Sonoran Zone deserts, occupying open country among bushes and clumps of cactus and showing a preference for more or less rocky situations. They dig shallow burrows under bushes or among rocks and apparently use also the burrows of other animals, especially those of the large kangaroo rats (*Dipodomys*). They apparently do not hibernate, but during severe weather may remain for long periods within their burrows. E. R. Sans says he has seen them out on top of a foot of snow. They are active, nervous, and very wary creatures, and when alarmed run rapidly to cover with their tails held straight up or curled over their backs. They are good climbers and are often seen sitting in a bush or clump of cactus, several feet above the ground. Their notes are described as "a shrill, rapid chipper." The young, numbering usually 6 to 9, or occasionally 12, are brought forth in March or April.

*Food habits.*—The food of the antelope squirrels consists chiefly of the seeds or berries of a large variety of desert shrubs. The fleshy fruit and the seeds of various species of cactus are frequently eaten, as are also seeds of mesquite, huisache (*Acacia farnesiana*),

yucca, palo verde (*Cercidium floridum*), ocotillo (*Fouquieria splendens*), sotol (*Dasyllirion texanum*), saltbush (*Atriplex*), Russian-thistle, skunkbush (*Rhus trilobata*), greasewood (*Sarcobatus*), sunflower, wild plum, and single leaf pinyon (*Pinus monophylla*). Small numbers of insects have been found in the animals' pouches.

A specimen taken at Resting Springs, Calif., February 9, 1891, had 46 grains of barley in its cheek pouches.

*Economic status.*—Living chiefly in desert regions, the antelope squirrels do not often come in contact with cultivated crops; but sometimes in irrigated valleys they are attracted to grainfields and gardens and in such cases may cause damage by destroying ripening grain or planted seeds of melons or corn.

#### MOHAVE GROUND SQUIRREL

*General habits.*—Burt (1936, p. 221) has given an account of the habits of the Mohave ground squirrel (*Citellus mohavensis*) based on a study made at Palmdale, Calif., in the spring of 1931. From this account, the following facts are selected.

The animals live on the lower desert, preferring areas where the soil is sandy or of sand mixed with gravel, and where there is a sparse growth of sagebrush. Their burrows enter the ground at an angle of about 35°; one examined was a simple tunnel 54 inches in length, 12 inches below the surface at its deepest point, with two entrance holes 2 to 2½ inches in diameter. Some of the burrows had been partially plugged with earth after the entrance of the animal.

The squirrels rarely run rapidly for any distance, and when danger threatens they dodge into a hole or sometimes crouch low on their bellies and remain quiet. When running the tail is carried over the back, after the manner of *Ammospermophilus*, but is not twitched. If slightly startled the animals rise upon their hind feet—"picket-pin" fashion—with the front legs hanging limply.

A squirrel observed for 50 minutes on April 12 fed in a patch of green vegetation, chiefly alfalfa; occasionally it climbed into small bushes to a height of about a foot and ate some green buds.

Its call "resembles a shrill whistle. It is a high pitched *peep*, with a slight rasping effect."

A female taken March 29 contained six embryos; one taken April 12 was suckling young.

#### ROUND-TAILED GROUND SQUIRRELS

*General habits.*—The round-tailed ground squirrels (*Citellus tereticaudus* subsp.) are typical desert animals, living in the hottest parts of the Lower Sonoran Zone in southern California and Arizona. They occur in more or less isolated colonies in mellow, sandy soil. Grinnell and Dixon (1918, p. 669) say that these ground squirrels prefer areas where wind-drifted sand has been accumulated into mounds about the bases of mesquite, creosote, or saltbushes. They make use of the burrows of other rodents, particularly kangaroo rats, but sometimes they dig burrows for themselves in the sandy flats or in the banks of a gulch or dike. These burrows may be 5 or 6 feet in length and reach a depth of 2 to 3 feet. Several examined by Vernon Bailey contained nests of grass at the lower end.



WHITE-TAILED ANTELOPE SQUIRREL (*CITELLUS LEUCURUS LEUCURUS*), LEFT.  
GRAY-TAILED ANTELOPE SQUIRREL (*C. HARRISII HARRISII*), RIGHT.



Living in a mild climate, these squirrels apparently do not hibernate completely, but they are rarely seen on cold or cloudy days during the winter season and may remain in their burrows for somewhat extended periods. At Fort Lowell, Ariz., in midwinter, A. Brazier Howell noted them out only about once a week until January 24, after which they became abundant. Early in February the females ventured out infrequently and appeared ragged, but the males were in good pelage. Near Tucson, Ariz., the first were seen out of their burrows on January 27. A specimen was taken at Needles, Calif., December 12, and one at Agua Caliente on January 15.

Although chiefly ground dwellers, these squirrels occasionally climb into bushes in search of food or to survey the surrounding country. Swarth (1929, p. 349) mentions seeing one 10 feet or more up in a mesquite tree. Their voice is described by Vernon Bailey as a fine shrill whistle, so thin and sharp that it sounds like the note of an insect. He says that there is no vibration or trill to it, as in the voice of the members of the *spilosoma* or the *tridecemlineatus* groups, but that it is often prolonged and evenly sustained.

The young are brought forth in March and April and there may be a second litter later in the season. Two specimens taken in Death Valley, Calif., April 7, contained six and seven embryos, respectively. Three taken at Fort Mohave, Ariz., March 11 and 12, contained 10, 11, and 12, respectively. One taken at Ivanpah, Calif., June 2, contained eight.

*Food habits.*—Stephens (1906, p. 70) says of this species:

The food is seeds the greater part of the year; these are stored to some extent. In the spring, during the few weeks when green vegetation is obtainable, leaves and buds are eaten voraciously.

Grinnell and Dixon (1918, p. 671) state that stems of the "squaw-tea" or jointfir (*Ephedra*) and leaves of the mesquite form an important element of the diet wherever and whenever obtainable. They state, also, on the authority of W. C. Jacobsen, that in the Imperial Valley these squirrels were known to invade alfalfa fields and to eat the alfalfa leaves, discarding the stems.

Among the food elements recorded in the stomachs or cheek pouches of this species are cactus fruit, blossoms of ocotillo (*Fouquieria splendens*), mesquite beans and leaves, seeds of plantain (*Plantago*) and of goosefoot (*Chenopodium*), wheat, barley, and small insects.

Living mainly in desert areas, these squirrels rarely come in contact with agricultural crops and they are therefore of little economic importance.

#### MANTLED GROUND SQUIRRELS

*General habits.*—The mantled ground squirrels (subgenus *Callospermophilus*) (pl. 11) inhabit mountain slopes and foothills, living in the more open forested country among rocks and fallen timber. Their burrows are dug usually under rocks or stumps, and the animals spend much time resting quietly on some rock or log in the sunshine. They occasionally climb into bushes or trees to a height of 20 or 30 feet in search of food, but their ordinary habitat is on the ground. They are of rather sluggish movements and when running, elevate the tail at an angle of about 45°. Ordinarily they are silent,

but Bailey says that on occasions they utter a clear, birdlike whistle, very shrill and piercing, entirely unlike the note of the chipmunks. When gathering food supplies, they often pack their capacious cheek pouches so full that their cheeks stand out as in a case of the mumps. In fall they store food in underground chambers.

*Hibernation.*—These squirrels become very fat early in fall and by the middle of September most of them have retired underground for their winter's sleep; a few, however, may be found out of their burrows in October or November (Lake Tahoe, Calif., Oct. 6; Tularosa Mountains, N. Mex., Oct. 12; Mogollon Mountains, N. Mex., Oct. 28; Pikes Peak, Colo., Nov. 2 (Hatt, 1927, p. 19)). In the Bitterroot Valley, Mont., the first one seen in spring was on March 28 (1910) and by April 10 they were observed in numbers. In milder climates they may come out of hibernation earlier than this. Females carrying four to six or rarely eight embryos are recorded during May, June, and July.

*Burrows and nests.*—Hatt (1927, p. 8) describes a burrow examined in Douglas County, Colo., as follows:

The diameter of the burrow at the entrance was 3 inches. For the distance of a foot there was a 45° angle and then the course flattened out to a depth uniformly 8 inches under the surface, except at the opposite end and in one of the pockets. A few inches past the entrance the tunnel narrowed down to a uniform 2-inch bore. At one place in its course the roof was crossed by the root of an aspen. Farther on the tunnel passed directly under the base of a tree and beneath its roots.

The first pocket leading from the main passage contained no debris of any sort, and at the time of the excavation could not have been in use unless it was a passing place or unlined nesting site.

Six feet in from the entrance the passage forked, one lead passing directly to the nest, the other passing to it by a semicircular arc. A runway surrounded the nest on three sides, from which there were four passages leading in. This nest cavity was 4 inches deep, the nest not filling the space available, but occurring more as a mat in the bottom of the cup.

A passage led away from the nest in the direction opposite from that of the other main passage. Six inches from the cavity this forked, one branch leading from an empty chamber 5½ inches in diameter, beyond which was a blind lead filled for a distance of about 12 inches with old nesting material, firmly packed. The other branch led by an angular path and a sharp grade to another entrance completely obscured by kinnikinnik and hidden by a mat of leaves.

*Food habits.*—The food of the mantled ground squirrels is chiefly of vegetable origin and comprises a large variety of the seeds and berries of wild plants, including acorns and seeds of yellow pine and Douglas fir, small wild beans, serviceberries (*Amelanchier*), gooseberries (*Grossularia irrigua*), currants, thimbleberries, and the seeds of roses, lupine, puccoon (*Lithospermum*), alfalfa, clover, *Polygonum*, shepherds-purse (*Capsella*), milkvetch (*Astragalus*), false-indigo (*Ammorpha californica*), willowweed (*Epilobium*), beardtongue (*Pentstemon*), bitterbrush (*Purshia tridentata*), gilia, and greengentian (*Frasera*). One squirrel captured had 410 weed seeds in its pouches; another had taken 360 grains of barley, gathered along a road. Mushrooms are frequently eaten, as also are grasshoppers, beetles, caterpillars, ants, flies, and various other insects. Hatt (1927, p. 12) reports seeing one of these squirrels feeding on the fruits of stickleaf (*Mentzelia multiflora*). Vernon Bailey examined a specimen in Oregon that had filled its cheek pouches to their limit with ripe seeds of the Nuttall violet (*Viola nuttallii*).



A. H. H. & Co. Lith. Baltimore.

GOLDEN-MANTLED GROUND SQUIRREL (*CITELLUS LATERALIS CHRYSODEIRUS*).



*Economic status.*—Living as they do chiefly in mountainous and unsettled areas, these squirrels rarely come in contact with civilization. In certain valleys, however, they at times forage in grain-fields and destroy considerable quantities of wheat, oats, or barley. Around hunters' or miners' camps they are often attracted by stores of food and unless means are taken to keep them out they will persistently carry off any food materials that appeal to their taste.

## CLASSIFICATION OF THE NORTH AMERICAN SCIURIDAE

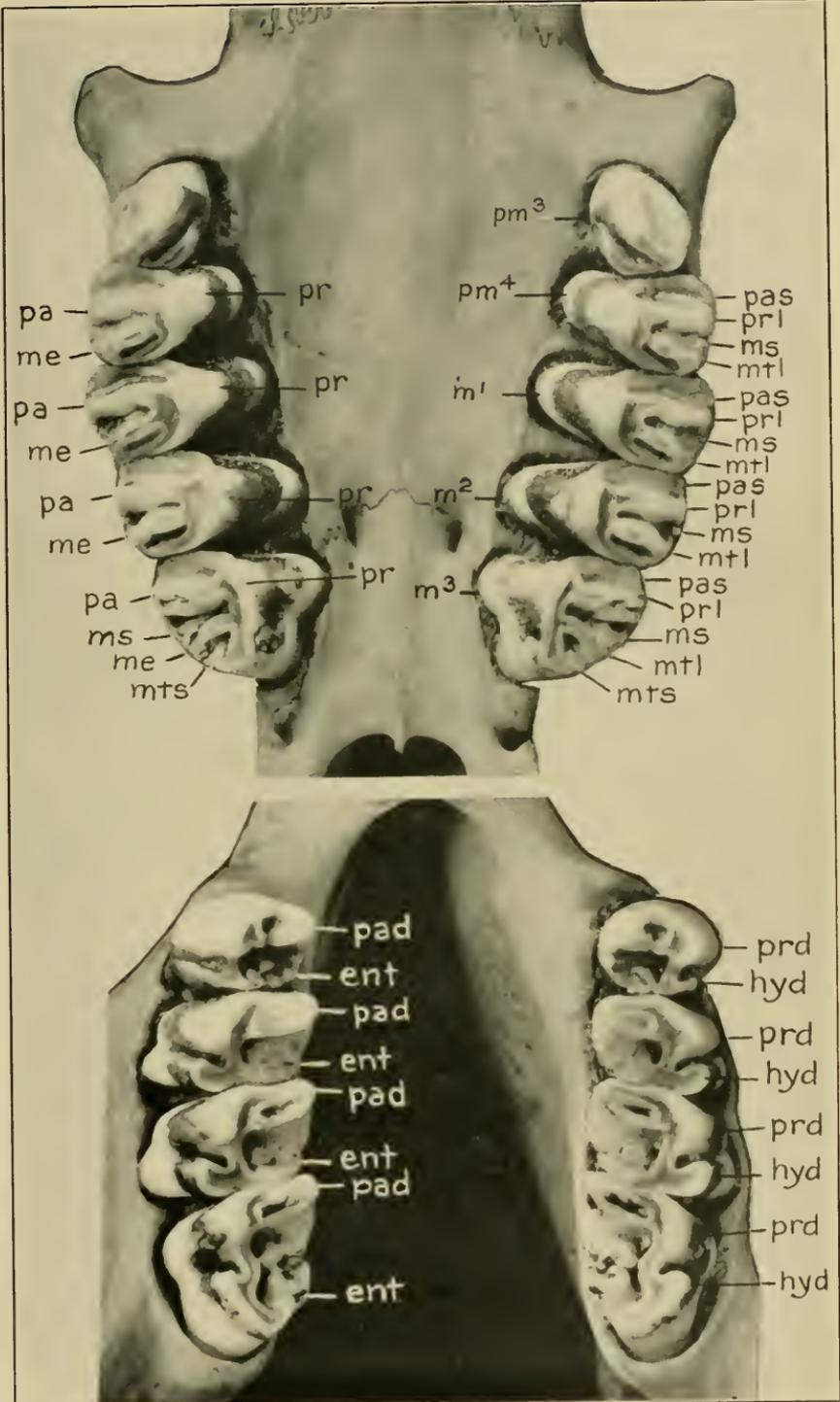
In connection with the present revision of the North American ground squirrels, it seemed desirable to make a critical study of all the North American members of the family Sciuridae, in an effort to devise a classification in which the generic and subgeneric groups can be based on the most constant and deep-seated skeletal characters. This has proved to be a task of considerable difficulty, for although the various groups commonly recognized are easily separable by external characters, critical study of their cranial and dental characters (pl. 12) reveals in many cases close relationship among a number of groups, shown by extensive gradation from one to another in supposedly diagnostic characters.<sup>3</sup>

The lack of agreement among zoologists as to what characters should be used to characterize a genus results in great diversity of treatment by systematic workers and consequent confusion of the laymen, who are naturally less interested in questions of relationship than in stability of the names they are called upon to use.

A genus is sometimes a natural group, but is often merely a concept in the mind of the systematist by which certain related species are associated under a single generic name. The limits of a particular genus, therefore, may be subject to change at the will of any reviser, as his viewpoint with reference to generic characters changes, or as new facts or new species come to his attention. This situation is well illustrated by the evolution of the generic concept in the mind of one of our most distinguished American zoologists, the late J. A. Allen. In his monograph of the Sciuridae, published in 1877, he recognized a single genus—*Sciurus*—for all the tree squirrels of North America and South America. The five outstanding groups of North America were treated as species (some with several varieties) and nine additional species were recognized from Middle America and South America. In his last paper on the squirrels, published 38 years later (1915), working, of course, with a vastly increased quantity of material, he recognized eight genera from North America and nine additional genera from South America. Each of the five North American species recognized in 1877 was in 1915 given full generic rank—*Tamiasciurus* for the red squirrels; *Neosciurus* for the eastern gray squirrel; *Otosciurus* for Abert's squirrel of the Southwest; *Hesperosciurus* for the western gray squirrel; and *Parasciurus* for the fox squirrels.

The same tendency to give generic rank to practically every recognizable group is more or less prevalent today among workers in other branches of zoology. Such a course results in our so-called genera becoming little more than specific groups. The purpose of

<sup>3</sup> In this study the writer has had the advice and assistance of Gerrit S. Miller, Jr., curator of mammals, U. S. National Museum, who generously turned over a partially completed key to the genera of ground squirrels and related groups and also checked with the author the cranial characters of the various groups.



UPPER AND LOWER MOLARIFORM TOOTH ROWS OF CYNOMYS LUDOVICIANUS.

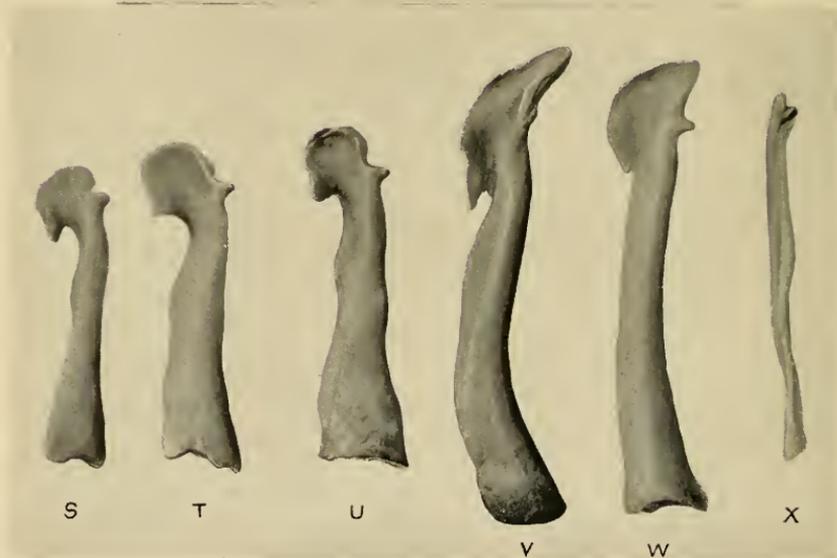
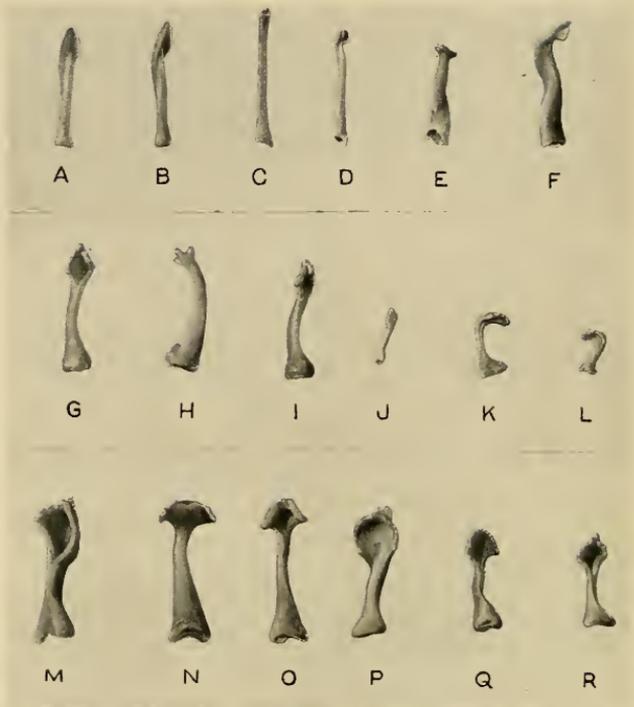
(Enlarged about 6 diameters.)

pa = paracone.  
me = metacone.  
pr = protocone.

pad = paraconid.  
ent = entoconid.  
prl = protoconid.

hyd = hypoconid.  
pas = parastyle.  
ms = mesostyle.

mts = metastyle.  
prl = protoloph.  
mtl = metaloph.



BACULA OF VARIOUS SCIURIDAE.

(Enlarged about  $3\frac{1}{2}$  diameters—see explanation on facing page.)

systematic nomenclature should be to show not only that there are *differences* between the various forms but also that there are *resemblances* that indicate relationship. Giving a generic name to every recognizable group emphasizes the differences between related groups but fails entirely to show their similarities.

A more reasonable and satisfactory classification will be attained by recognizing as subgenera groups that are distinguished by cranial characters of minor importance, or that show gradation in cranial or dental characters from one group to another. This treatment should be satisfactory both to the layman and to the systematist. One who is interested chiefly in having a definite and permanent name to use for every species may disregard the subgeneric name entirely, while the technical worker who desires to show the relationship of the various groups can do so by the use of both generic and subgeneric names.

Examination of the baculum (pl. 13), or penis bone, in a small number of individuals representing most of the subgeneric groups shows that this bone has characters that are of assistance in defining the groups. The writer does not believe, however, that in the absence of trenchant cranial characters, the morphology of the baculum alone should be considered of generic value.

The North American Sciuridae may be roughly divided into four groups, as follows:

1. The marmots (*Marmota*), prairie dogs (*Cynomys*), and ground squirrels (*Citellus*), including the rock squirrels (*Otospermophilus*), mantled ground squirrels (*Callospermophilus*), and antelope squirrels (*Ammospermophilus*), which three heretofore have been treated by some writers as genera.
2. The chipmunks (*Tamias* and *Eutamias*).
3. The tree squirrels (*Sciurus*, *Tamiasciurus*, *Microsciurus*, and *Syntheosciurus*).
4. The flying squirrels (*Glaucomys*).

#### EXPLANATION OF PLATE 13

(Enlarged about 3½ diameters)

- |   |   |
|---|---|
| A. <i>Tamias striatus</i> .   | L. <i>Citellus</i> ( <i>Ammospermophilus</i> ) <i>har-</i><br><i>risionii</i> .   |
| B. <i>Tamias striatus</i> .   | M. <i>Cynomys</i> ( <i>Cynomys</i> ) <i>ludovicianus</i> .                        |
| C. <i>Eutamias</i> ( <i>Eutamias</i> ) <i>asiaticus</i> .                               | N. <i>Citellus</i> ( <i>Ictidomys</i> ) <i>tridecemline-</i><br><i>atus</i> .     |
| D. <i>Eutamias</i> ( <i>Neotamias</i> ) <i>townsendii</i><br><i>sonomae</i> .           | O. <i>Citellus</i> ( <i>Ictidomys</i> ) <i>mexicanus</i> .                        |
| E. <i>Eutamias</i> ( <i>Neotamias</i> ) <i>quadrivitta-</i><br><i>tus frater</i> .      | P. <i>Citellus</i> ( <i>Poliocitellus</i> ) <i>franklinii</i> .                   |
| F. <i>Eutamias</i> ( <i>Neotamias</i> ) <i>cinereicollis</i> .                          | Q. <i>Citellus</i> ( <i>Citellus</i> ) <i>beldingi oregonus</i> .                 |
| G. <i>Citellus</i> ( <i>Otospermophilus</i> ) <i>varie-</i><br><i>gatus grammurus</i> . | R. <i>Citellus</i> ( <i>Xerospermophilus</i> ) <i>tereti-</i><br><i>caudus</i> .  |
| H. <i>Citellus</i> ( <i>Otospermophilus</i> ) <i>variega-</i><br><i>tus grammurus</i> . | S. <i>Sciurus</i> ( <i>Neosciurus</i> ) <i>carolinensis</i> .                     |
| I. <i>Citellus</i> ( <i>Otospermophilus</i> ) <i>variega-</i><br><i>tus buckleyi</i> .  | T. <i>Sciurus</i> ( <i>Neosciurus</i> ) <i>variegatoides</i><br><i>dorsalis</i> . |
| J. <i>Citellus</i> ( <i>Callospermophilus</i> ) <i>later-</i><br><i>alis</i> .          | U. <i>Sciurus</i> ( <i>Parasciurus</i> ) <i>niger limitis</i> .                   |
| K. <i>Citellus</i> ( <i>Ammospermophilus</i> ) <i>har-</i><br><i>risionii</i> .         | V. <i>Sciurus</i> ( <i>Hesperosciurus</i> ) <i>griseus</i> .                      |
|   | W. <i>Sciurus</i> ( <i>Otosciurus</i> ) <i>aberti</i> .                           |
|   | X. <i>Glaucomys volans</i> .  |

The marmots, prairie dogs, and ground squirrels are all closely related. In comparison with the tree squirrels they are characterized in general by a shallower brain case; narrower interorbital region; more wide-spreading zygomata, which are usually not parallel but contracted anteriorly and twisted in the jugal region from a vertical toward a horizontal plane; the upper surface of the jugal is without an angular process; the antorbital foramen is broader (either subtriangular or oval); the molars are usually more hypsodont and the crown pattern more complicated; and the anterior upper premolar ( $pm^3$ ) is always present and often of relatively large size. This tooth is of varying size in the different groups of ground squirrels and furnishes a character useful in distinguishing the subgenera.

## KEY TO GENERA AND SUBGENERA

- $a^1$ . No antorbital canal, the antorbital foramen piercing the zygomatic plate of the maxillary.
- $b^1$ . Premolars  $\frac{1}{2}$ ----- Genus *TAMIAS* (p. 46)
- $b^2$ . Premolars  $\frac{2}{3}$ ----- Genus *EUTAMIAS* (p. 47)
- $c^1$ . Antorbital foramen large, suborbicular----- Subgenus *EUTAMIAS* (p. 47)
- $c^2$ . Antorbital foramen smaller, narrowly oval. Subgenus *NEOTAMIAS* (p. 47)
- $a^2$ . Antorbital canal present.
- $b^1$ . Anterior lower premolar bearing a paraconulid--- Genus *MARMOTA* (p. 37)
- $c^1$ . Pollex suppressed----- Subgenus *MARMOTA* (p. 38)
- $c^2$ . Pollex present----- Subgenus *MARMOTOPS* (p. 38)
- $b^2$ . Anterior lower premolar without a paraconulid.
- $c^1$ . Zygomata not parallel, but contracted anteriorly, and anterior portion twisted toward a horizontal plane (ground squirrels and prairie dogs).
- $d^1$ . Upper molar rows strongly convergent posteriorly----- Genus *CYNOMYS* (p. 38)
- $e^1$ . Jugal thickened anteriorly----- Subgenus *CYNOMYS* (p. 38)
- $e^2$ . Jugal not thickened anteriorly. Subgenus *LEUCOCROSSUROMYS* (p. 38)
- $d^2$ . Upper molar rows not strongly convergent posteriorly----- Genus *CITELLUS* (p. 39)
- $e^1$ . Molars relatively hypsodont; parastyle ridge on  $m^1$  and  $m^2$  joining protocone with an abrupt change of direction.
- $f^1$ . Metaloph on  $pm^4$  continuous----- Subgenus *CITELLUS* (p. 40)
- $f^2$ . Metaloph on  $pm^4$  not continuous----- Subgenus *ICTIDOMYS* (p. 41)
- $e^2$ . Molars relatively brachydont; parastyle ridge on  $m^1$  and  $m^2$  rising evenly to join the protocone, without abrupt change of direction.
- $f^1$ . Anterior upper premolar simple; less than one-fourth the size of  $pm^4$ .
- $g^1$ . Upper incisors relatively stout and distinctly recurved.
- $h^1$ . Brain case rounded on upper surface.
- $i^1$ . Supraorbital foramen open----- Subgenus *OTOSPERMOPHILUS* (p. 43)
- $i^2$ . Supraorbital foramen closed----- Subgenus *NOTOCITELLUS* (p. 44)
- $h^2$ . Brain case flattened on upper surface----- Subgenus *AMMOSPERMOPHILUS* (p. 44)
- $g^2$ . Upper incisors relatively slender—not distinctly recurved.
- $h^1$ . Postorbital processes long and slender; rostrum longer----- Subgenus *CALLOSPERMOPHILUS* (p. 45)
- $h^2$ . Postorbital processes short and stout; rostrum shorter----- Subgenus *XEROSPERMOPHILUS* (p. 45)
- $f^2$ . Anterior upper premolar more than one-fourth the size of  $pm^4$ , showing two cusps or a functional cutting edge----- Subgenus *POLIOFITELLUS* (p. 42)

- c*<sup>3</sup>. Zygomata nearly parallel (little if any contracted anteriorly) and nearly vertical—not twisted (tree squirrels).
- d*<sup>1</sup>. Interorbital region relatively narrow and deeply notched----- Genus *GLAUCOMYS* (p. 52)
- d*<sup>2</sup>. Interorbital region relatively broad and not deeply notched.
- e*<sup>1</sup>. Upper incisors projecting forward (to or beyond plane of tip of nasals).
- f*<sup>1</sup>. Upper incisors grooved----- Genus *SYNTHEOSCIURUS* (p. 52)
- f*<sup>2</sup>. Upper incisors not grooved----- Genus *MICROSCIURUS* (p. 51)
- e*<sup>2</sup>. Upper incisors not projecting forward----- Genus *SCIURUS* (p. 48)
- f*<sup>1</sup>. Premolars  $\frac{1}{2}$ .
- g*<sup>1</sup>. Notch in zygomatic plate of maxillary opposite  $m^1$ ----- Subgenus *PARASCIURUS* (p. 50)
- g*<sup>2</sup>. Notch in zygomatic plate of maxillary opposite  $pm^4$  (or sometimes the division between  $pm^4$  and  $m^1$ )----- Subgenus *GUERLINGUETUS* (p. 50)
- f*<sup>2</sup>. Premolars  $\frac{3}{4}$ .
- g*<sup>1</sup>. Notch in zygomatic plate of maxillary opposite  $pm^4$ .
- h*<sup>1</sup>. Anterior upper premolar ( $pm^3$ ) well developed; baculum present----- Subgenus *SCIURUS* (p. 48)
- h*<sup>2</sup>. Anterior upper premolar ( $pm^3$ ) vestigial—often absent; baculum absent----- Genus *TAMIASCIURUS* (p. 51)
- g*<sup>2</sup>. Notch in zygomatic plate of maxillary opposite  $m^1$ .
- h*<sup>1</sup>. Second upper premolar ( $pm^4$ ) broader than long----- Subgenus *HESPEROSCIURUS* (p. 49)
- h*<sup>2</sup>. Second upper premolar ( $pm^4$ ) not broader than long.
- i*<sup>1</sup>. Interorbital breadth greater than postorbital breadth----- Subgenus *OTOSCIURUS* (p. 50)
- i*<sup>2</sup>. Interorbital breadth not greater than postorbital breadth----- Subgenus *NEOSCIURUS* (p. 48)

#### Genus *MARMOTA*: Marmots

*Marmota* Blumenbach, Handbuch der Naturgeschichte 1: 79, 1779 (type, *Mus marmota* Linnaeus).

The marmots, woodchucks, or ground hogs attain the largest size of any of the Sciuridae. The skull is nearly flat on top, the tip of the rostrum slightly depressed; the brain case is very broad, the zygomatic arches wide-spreading, their anterior portion thickened; the postorbital processes are very broad, not greatly depressed, projecting nearly at right angles to the axis of the skull at about the middle portion of the orbit.

The upper molars are heavy, subquadrate, and brachydont, with heightened inner cones; the anterior upper premolar is about one-third as large as  $pm^4$ ;  $pm^4$  is about as long as broad, or slightly longer, with a prominent parastyle separated from the proto-loph by a broad valley; the parastyle ridge on  $m^1$  and  $m^2$  is low and joins the protocone with an abrupt change of direction; the metaloph on  $pm^4$ ,  $m^1$ , and  $m^2$  is more or less interrupted; on  $m^3$  it turns backward to join the heel. The lower molars are heavy, with prominent cones and deep valleys; on the anterior lower premolar the protoconid and paraconid are separated by a broad sulcus, and there are one or two small cusplets on the anterior face of the tooth between the two principal cusps.

The upper incisors are heavy, and less compressed laterally than in *Citellus*, their anterior face smoothly rounded.

## Subgenus MARMOTA

Pocock (1923a, p. 1200) has divided the genus *Marmota* on the presence or absence of the pollex. The type species—*M. marmota*, of Europe—apparently differs from all the other species in the complete absence of this digit. Comparison of the skulls of *M. marmota* and *M. monax* shows no distinguishing characters of more than specific value.

## Subgenus MARMOTOPS

*Marmotops* Pocock, Zool. Soc. London Proc. 1922: 1200, 1923 (type, *Marmota monax*).

As shown by Pocock and verified by examination of specimens in the United States National Museum, all the American and Eurasian species except *M. marmota* possess a rudimentary thumb (pollex) bearing a broad, flat nail. This character is considered to be of sub-generic value.

## Genus CYNOMYS: Prairie Dogs

*Cynomys* RAFINESQUE, Amer. Monthly Mag. 2: 45, 1817 (type, *Cynomys socialis* Rafinesque = *C. ludovicianus*).

The prairie dogs are more closely related to the ground squirrels (*Citellus*) than to the marmots. The skull of *Cynomys* resembles that of *Citellus parryi* rather closely in general contour, but differs in several important characters. The molariform teeth are very heavy, much broader than long, high crowned on inner side; the inner roots of  $m^1$  and  $m^2$  are greatly enlarged and the outer roots correspondingly reduced; the upper tooth rows are strongly convergent posteriorly, instead of being nearly parallel as in *Marmota* and *Citellus*. The anterior premolar is always very large—more than half the size of  $pm^4$ —its outline oval rather than subcircular. The transverse ridges on  $m^1$  and  $m^2$  are more crowded than in *Citellus*, with a relatively shallow valley between; on the last upper molar the crown pattern is more complicated, having two complete transverse ridges and an additional ridge extending from the mesostyle partly across the tooth; the last lower molar is decidedly longer than  $m_2$  and the crown pattern is more complicated than the corresponding tooth in *Citellus*; this tooth has an enlarged heel, with a greater development of the enamel folds, which extend from the inner side and practically fill the talonid basin (pl. 12; pl. 14, *G*; pl. 17, *G*; pl. 20, *A*).

The baculum of *Cynomys ludovicianus* resembles that of the ground squirrels in shape; it is 4.9 mm in length, the shaft rather stout and greatly thickened at the proximal end; the distal end is expanded in the shape of a deep scoop, the edges of which are irregularly denticulate; the shaft is continued on the under side of the scoop as a narrow process (pl. 13, *M*).

## Subgenus CYNOMYS

Characters as given above for the genus; further characterized by the relatively heavy jugal, which at the angle of the ascending branch is thickened and shows a prominent triangular process.

## Subgenus LEUCOCROSSUROMYS

*Leucocrossuromys* HOLLISTER, North Amer. Fauna 40: 23, 1916 (type, *Spermophilus gunnisoni* Baird).

The skull of this subgenus is similar to that of typical *Cynomys*; the general shape of the occipital region, viewed from behind, is elliptical-oval; the jugal is relatively "weak, thin, and flat, the outer surface at angle of ascending branch only very slightly thickened, the margin rounded, not triangular" (Hollister, op. cit.).

#### Genus CITELLUS: Ground Squirrels

*Citellus* Oken, Lehrbuch der Zoologie (3) 2: 842, 1816 (type, *Mus citellus* Linnaeus).

The ground squirrels are represented in North America by 31 species arranged in 8 subgenera and 12 well-marked groups, easily distinguished by their color pattern. These comprise the species commonly referred to typical *Citellus* (in which are represented several minor groups); the striped and the spotted ground squirrels (*Ictidomys*); Franklin's ground squirrel (*Poliocitellus*); rock squirrels (*Otospermophilus*); ring-tailed ground squirrels (*Notocitellus*); antelope squirrels (*Ammospermophilus*); desert ground squirrels (*Xerospermophilus*), containing only two plain-colored forms; and mantled ground squirrels (*Callospermophilus*).

Some of these groups now rank as genera, others as subgenera; *Ammospermophilus* and *Callospermophilus* apparently have been accorded generic rank largely by reason of their external characters. Detailed comparison of the skulls of all the species of ground squirrels shows them to be closely related, the various groups differing in relative proportions of the skull and teeth.

The molars vary in height of crown from the hypsodont type found in typical *Citellus* to the brachydont type found in *Otospermophilus*, *Callospermophilus*, and *Ammospermophilus*; the anterior premolar (always present) varies from the large functional tooth found in *C. parryii*—fully one-third as large as the adjoining premolar ( $pm^4$ )—to the small, peglike tooth of *Ammospermophilus*, which is scarcely one-tenth as large as the next premolar, and but little larger than the corresponding tooth in *Eutamias*.

The upper incisors vary from a long, slender, forward-projecting type found in *C. parryii* to the short, stout, recurved teeth of *C. annulatus*, which in this character strongly resembles some of the tree squirrels.

#### GENERIC CHARACTERS

The genus *Citellus* differs from *Sciurus* in having a much shallower brain case; the zygomata are contracted anteriorly, the anterior portion twisted toward a horizontal plane; the upper surface of the jugal is without a prominent process; the antorbital foramen forms a canal, oval or subtriangular in shape; the molariform teeth are less primitive and usually much more hypsodont;  $pm^3$  is always present, though variable in size. *Citellus* differs from *Cynomys* as follows: Upper molariform tooth rows parallel or only slightly convergent posteriorly; upper molars relatively lighter and less hypsodont; last upper molar with enamel pattern less complicated, the metaloph present in some species, absent in others, but never with an additional subsidiary loph; last lower molar likewise with less complicated enamel folding, the talonid basin present, as in  $m_1$  and  $m_2$ .

## Subgenus CITELLUS

*Type.*—*Mus citellus* Linnaeus.

## CRANIAL CHARACTERS

Dorsal profile of skull moderately convex; parietal ridges faintly indicated; brain case subglobular, about as broad as long; postorbital processes long, slender, and decurved; zygomata moderately heavy, broadly expanded posteriorly, narrowing strongly anteriorly; antorbital foramen large, suborbicular.

Molariform tooth rows parallel or slightly convergent posteriorly; upper incisors relatively slender; anterior upper premolar ( $pm^3$ ) more than one-third the size of  $pm^4$ , bearing a simple, functional, obliquely transverse ridge; molars hypsodont, broader than long; transverse ridges on  $pm^4$ ,  $m^1$ , and  $m^2$  forming a narrow U; parastyle ridge on  $m^1$  and  $m^2$  very low, joining protocone with an abrupt change of direction (almost a right angle);  $m^3$  with posterior loph obsolete in some species, present in others, and variable in some.

A series of 12 specimens of *C. citellus*—type of the genus—from Hungary, recently acquired through the cooperation of the Hungarian National Museum, makes it possible to define the characters of the type species in comparison with the American species of the genus. The skull of *C. citellus* (pl. 14, *E*; pl. 17, *E*; pl. 20, *D*) is similar in general to that of *C. beldingi*, but slightly smaller and more weakly built; dorsal profile moderately convex; parietal ridges slightly indicated; brain case subglobular, about as broad as long; posterior truncation of brain case nearly vertical; lambdoid crest moderately prominent; paroccipital processes moderate; interorbital breadth somewhat less than postorbital constriction; postorbital processes long, slender, and decurved; zygomata moderately heavy, broadly expanded posteriorly, narrowing strongly anteriorly; rostrum narrow, its sides nearly parallel; nasals narrowing slightly posteriorly, extending slightly beyond nasal branches of premaxillaries; antorbital foramen large, suborbicular; incisive foramina short and broad; molariform tooth rows slightly convergent posteriorly; pterygoids long and slender; auditory bullae moderately inflated and evenly rounded, without external meatus.

Upper incisors slender, nearly perpendicular to basi-cranial axis; molars hypsodont, broader than long; anterior upper premolar ( $pm^3$ ) more than one-third the size of  $pm^4$ , bearing a simple, functional, obliquely transverse ridge;  $pm^4$ ,  $m^1$ , and  $m^2$  with high transverse ridges forming a narrow U; parastyle ridge on  $m^1$  and  $m^2$  very low, joining protocone at almost a right angle; metastyle on  $pm^4$ ,  $m^1$ , and  $m^2$  low and weakly developed, not directly joined to the protocone;  $m^3$  with posterior ridge (metaloph) obsolete; lower molars hypsodont, the anterior cusps much higher than the posterior, with a distinct narrow transverse ridge joining the protoconid with the paraconid;  $pm_4$  with the two anterior cusps separated by a broad sulcus.

## EXTERNAL CHARACTERS

The species associated in the typical subgenus *Citellus* vary greatly in external characters. In all forms the ears are rather low, in some but little raised above the crown, in others of medium height, but

not pointed. The tail may be about half the length of the body or much shorter. The coloration varies from plain to mottled or spotted.

#### BACULÆ CHARACTERS

The baculum from a specimen of *Citellus beldingi oregonus* is 3.5 mm in length; its shaft is broad at the base, slightly curved, and narrowed toward the tip, which is shaped like a spoon with a crenulate border. The apex of the shaft appears as a short process projecting from the lower surface of the terminal disk (pl. 13, Q).

#### Subgenus ICTIDOMYS

*Ictidomys* Allen, Monog. North Amer. Rodentia, p. 821, 1877 (type, *Sciurus tridecemlineatus* Mitchill).

*Ictidomoides* Mearns, U. S. Natl. Mus. Bull. 56: 328, 1907 (type, *Sciurus mexicanus* Erxleben).

As originally proposed by Allen the subgenus *Ictidomys* comprised the species *tereticaudus*, *mexicanus*, *tridecemlineatus*, and *franklinii*. The type has been fixed by Merriam (Allen, 1895a, p. 418) as *Citellus tridecemlineatus*; *tereticaudus* has been removed to another subgenus and *franklinii* is here made the type of a new subgenus. *Ictidomoides*, proposed by Mearns (1907, p. 328) for *C. mexicanus*, appears to be inseparable from *Ictidomys*. *C. spilosoma* and *C. perotensis* are also included in this subgenus.

#### CRANIAL CHARACTERS

*Ictidomys* differs from typical *Citellus* in having a relatively narrower brain case; the rostrum tapering gradually; upper incisors relatively stouter, shorter, and distinctly recurved; anterior upper premolar relatively much smaller (less than one-third as large as  $pm^4$ ), its crown sometimes developing a short cutting edge, but often appearing as a single cusp; metaloph of  $pm^4$ ,  $m^1$ , and  $m^2$  not continuous, the metacone separated from the protocone by a distinct sulcus; on  $m^3$  the metaloph is obsolete (pl. 14, C; pl. 17, C; pl. 20, H).

#### EXTERNAL CHARACTERS

Body rather slender; tail distichous, 60 to 80 percent of the head and body; ears short and broad, rising but little above the crown; claws on front feet long and slender, the third longest, the second and fourth about equal, the fifth much shorter; thumb very short, but bearing a rudimentary claw. Claws on hind feet shorter and stouter, the first very short, the fifth somewhat longer, second and fourth about equal, and third slightly longer. Cheek pouches of moderate size; mammae usually 10 or 12: pectoral,  $\frac{3}{2}$ , abdominal,  $\frac{2}{2}$  or  $\frac{3}{3}$ , inguinal,  $\frac{1}{1}$ .

The pelage in this subgenus is dense and soft, and of moderate length. Apparently there is but one molt annually, occurring in April or May, but its progress is not clearly shown by any of the specimens examined.

The color pattern in the type species consists of a series of alternating light and dark stripes, with whitish spots in the middle of

the dark stripes; in *C. mexicanus* the dorsal stripes are all broken into spots; *C. spilosoma* and *C. perotensis* are irregularly spotted on a plain background.

#### BACULAR CHARACTERS

The baculum of *C. tridecemlineatus*—the type of this subgenus—consists of a nearly straight shaft 4.9 mm long, much thickened at the proximal end, tapering rather abruptly, the distal end upturned and widely expanded into a shallow "scoop", with a wide cleft in the center; the margin of the scoop on either side with shallow crenulations; there is no process at the tip of the shaft (pl. 13, *N*).

The baculum of *C. mexicanus* is similar to that of *C. tridecemlineatus*, but the tip is less widely expanded and more sharply upturned on the sides, thus producing a deeper hollow in the center of the scoop. The tip of the shaft shows as a process from the under side of the scoop. As in *C. tridecemlineatus*, the border of the disk shows slight crenulations (pl. 13, *O*).

#### POLIOCITELLUS, subgenus nov.

Type.—*Arctomys franklinii* Sabine.

#### CRANIAL CHARACTERS

*Citellus franklinii* differs in many rather striking characters from the other ground squirrels and may well be recognized as a subgenus. In many of its characters it furnishes a connecting link between *Ictidomys* and *Otospermophilus*. It differs from *Citellus* in the general contour of the skull, which is relatively long and narrow, with the superior outline flattened and the rostrum not pinched in at base. The zygomata are less widely expanded than in *Citellus* or *Otospermophilus*; the interorbital region is much longer than in *Citellus*, much as in *Otospermophilus* but relatively narrower; its border is usually without a notch, the supraorbital foramen closed in the majority of specimens; the postorbital processes are much as in *Citellus*—slenderer than in *Otospermophilus*—the upper incisors resemble those of *Otospermophilus*, and are stouter than those of *Citellus*; the upper molars are similar to those of *Otospermophilus*, but somewhat more hypsodont, the accessory tubercles on  $m^1$  and  $m^2$  more prominent. Compared with *Citellus* the upper molars are much lower-crowned and relatively longer (antero-posteriorly); the parastyle ridge rises gradually to join the protocone, without an abrupt change in direction; the transverse ridges are more widely spaced and the metaloph on  $pm^4$ ,  $m^1$ , and  $m^2$  is frequently discontinuous; on  $m^3$  the metaloph is absent. The anterior upper premolar ( $pm^3$ ) is peculiar, usually showing two distinct cusps, the outer one being higher than the inner. This tooth is relatively larger than in *Otospermophilus* but not as large as in *Citellus*, being one-fourth to one-third the size of  $pm^4$  (pl. 14, *B*; pl. 17, *B*; pl. 20, *E*).

#### EXTERNAL CHARACTERS

Body and limbs slender, resembling those of the tree squirrels (*Sciurus*); tail more than half as long as the head and body, some-

what bushy; ears low and evenly rounded; coloration uniform, with indistinct mottling; mammae 10 or 12; pectoral,  $\frac{2}{3}$ ; abdominal,  $\frac{1}{4}$  or  $\frac{2}{3}$ ; inguinal,  $\frac{2}{3}$ ; cheek pouches small; claws stout, slightly curved.

The pelage is dense and rather harsh; plain or dappled; the method and time of molting is not evident from examination of museum specimens.

#### BACULAR CHARACTERS

Baculum 4.3 mm in length, shorter and stouter than that of *C. tri-decemlineatus*, the shaft sharply bent upward near the terminal disk, which is 1.6 mm broad, shaped like a saucer and without pronounced crenulations on its margin. The tip of the shaft projects from the under side of the disk as a flattened process having a shallow sulcus on the anterior border (pl. 13, *P*).

#### Subgenus OTOSPERMOPHILUS

*Otospermophilus* Brandt, Bull. Class. Phys.-Math. Acad. Imp. Sci. St. Petersburg, 2: 379, 1844 (type, *Sciurus grammurus* Say).

The subgenus *Otospermophilus*, proposed for the "eared spermophiles", comprising the rock squirrels (*beecheyi*, *grammurus*, etc.), *C. (Callospermophilus) lateralis*, and *C. (Ictidomys) mexicanus*, has been restricted by elimination to the *Citellus beecheyi-grammurus* group.

#### CRANIAL CHARACTERS

Skull similar to that of *Citellus (Poliocitellus) franklinii*, but brain case broader and relatively shallower; interorbital region broader; rostrum short and broad, tapering gradually; antorbital foramen narrowly oval. Upper incisors stout, recurved; anterior upper premolar relatively small, about one-sixth the size of *pm*<sup>4</sup>; upper molars low-crowned, nearly quadrate; transverse ridges on *pm*<sup>4</sup>, *m*<sup>1</sup>, and *m*<sup>2</sup> more widely separated than in typical *Citellus* and less completely united with the protocone; posterior loph on *m*<sup>1</sup> and *m*<sup>2</sup> frequently broken up into one or two islandlike cusps; *m*<sup>3</sup> without metaloph (pl. 15, *F*; pl. 18, *F*; pl. 21, *G*).

#### EXTERNAL CHARACTERS

Body and limbs moderately slender; ears larger than in *Poliocitellus* or typical *Citellus*; tail about two-thirds the length of the head and body, somewhat bushy; cheek pouches large.

#### BACULAR CHARACTERS

The baculum of a specimen of *C. variegatus grammurus* (pl. 13, *G*) from Tucson, Ariz., is similar to that of *C. (Citellus) beldingi oregonus* but is slightly longer (4.5 mm) with fewer "teeth" on the terminal portion; the shaft is nearly straight, and its tip projects beyond the triangular-shaped "spoon" as a prominent process. Another specimen (pl. 13, *H*) differs from the one just described in being more strongly curved, and instead of a spoon-shaped disk at the tip the baculum divides into three blunt processes. This suggests that in a larger series other variations may occur. A baculum of *C. v. buckleyi* (pl. 13, *I*) resembles that of *C. v. grammurus*, but the disk is narrower.

## NOTOCITELLUS, subgenus nov.

*Type.*—*Spermophilus annulatus* Audubon and Bachman.

## CRANIAL CHARACTERS

Skull similar to that of *Citellus* (*Otospermophilus*) *beecheyi* but interorbital region relatively broader; supraorbital foramen always closed; rostrum short, the nasals relatively broader posteriorly; zygomata less widely expanded posteriorly; incisors relatively shorter and thicker antero-posteriorly; molariform teeth as in *Otospermophilus*. Compared with *C.* (*Poliocitellus*) *franklinii* the skull of *Notocitellus* is relatively broader in the interorbital region, the rostrum is shorter and broader, and the molariform teeth are lower crowned, with  $p^3$  relatively smaller (pl. 26, *D*; pl. 31, *D*).

## EXTERNAL CHARACTERS

Form slender; tail more than two-thirds the length of head and body, distichous, not bushy; feet long and slender; claws sharp, recurved; ears shorter and less pointed than in *Otospermophilus*, their superior margin evenly rounded. Pelage thin and somewhat harsh. Color pattern plain. Cheek pouches large (*vide* Audubon and Bachman).

## Subgenus AMMOSPERMOPHILUS

*Ammospermophilus* Merriam, Biol. Soc. Wash. Proc. 7:27, April 13, 1892 (type, *Tamias leucurus* Merriam).

## CRANIAL CHARACTERS

Skull similar to that of *Otospermophilus*, but brain case more rectangular, relatively broader at the posterior end, and distinctly flattened on the upper surface; lambdoid crest much reduced; auditory bullae relatively larger; zygomata appressed, only slightly expanded at posterior end.

This subgenus agrees with *Otospermophilus* in the shape of the antorbital foramen and in the attachment of the maxillary roots of the zygomata. The postorbital processes are small and slender; the upper incisors are stout and recurved much as in *C. adocetus*; the molariform teeth are essentially like those of *Otospermophilus*; the anterior upper premolar is a small, simple, peglike tooth, but little larger than the corresponding tooth in *Eutamias* (pl. 15, *E*; pl. 18, *E*; pl. 21, *D*).

## EXTERNAL CHARACTERS

Form as in most of the small ground squirrels; legs rather short, tail about half the length of the body, distichous, well-haired; ears short, broad and rounded; cheek pouches large; mammae, 10. The color pattern consists of a uniform background, with a single longitudinal white stripe on each side.

## BACULAR CHARACTERS

The baculum resembles that of the subgenus *Citellus*; the proximal end of the bone is thickened and laterally expanded; the shaft is straight and slender; the distal end is bent at right angles to the

shaft, and expanded into the shape of a shallow scoop, the edges of which are crenulate. Two specimens measured, respectively, 1.5 mm and 2.2 mm in length (pl. 13, *K* and *L*).

Subgenus **XEROSPERMOPHILUS**

*Xerospermophilus* Merriam, Biol. Soc. Wash. Proc. 7: 27, April 13, 1892 (type, *Spermophilus mohavensis* Merriam).

CRANIAL CHARACTERS

Skull short and broad, similar in general shape to that of *Citellus townsendii mollis* but relatively broader in the interorbital region; postorbital processes shorter, broad at base, rapidly tapering to a point; rostrum short and broad, tapering gradually; brain case broad and slightly flattened; zygomata stout and moderately expanded; upper incisors moderately stout and slightly recurved; molars brachydont (much as in *Otospermophilus*);  $m^1$  and  $m^2$  slightly broader than long, the transverse ridges rather widely spaced; anterior upper premolar small, less than one-fourth the size of  $pm^4$ ; audital bullae moderately inflated.

Compared with *Ammospermophilus* this subgenus differs in having a shorter brain case; heavier zygomata; interorbital region narrower; antorbital foramen broader and more orbicular; anterior upper premolar relatively larger; postorbital processes stouter; audital bullae smaller (pl. 14, *D*; pl. 17, *D*; pl. 20, *B*).

EXTERNAL CHARACTERS

Body stocky; feet stout; claws long, sharp, curved; soles densely haired; palms naked; thumb rudimentary, bearing a broad nail; teats, 10; ears very low—a mere rim—tail 40–60 percent of the body length, somewhat cylindrical, well haired, but appearing terete when worn; pelage soft and silky when fresh, harsh when worn; coloration plain.

BACULAR CHARACTERS

The baculum of *Citellus tereticaudus* is similar to that of *C. grammurus*, but shorter, measuring 3.5 mm in length; the shaft is much enlarged at the base and slightly curved upward; the tip broadens out to form a nearly circular "spoon" with pronounced crenulations on the margin; the tip of the shaft projects well beyond the border of the disk on the under side (pl. 13, *R*).

Subgenus **CALLOSPERMOPHILUS**

*Callospermophilus* Merriam, Biol. Soc. Wash. Proc. 11: 189, July 1, 1897 (type, *Sciurus lateralis* Say).

CRANIAL CHARACTERS

Skull very similar in general shape and in proportions to that of *Otospermophilus*, but upper incisors relatively slenderer and less chiseled off on inner face; molariform teeth not appreciably different. Compared with *Notocitellus*: Skull relatively narrower interorbitally, the supraorbital foramen opening into the orbit; rostrum relatively narrower; upper incisors decidedly slenderer, zygomata more widely

spread posteriorly; incisive foramina relatively larger (pl. 14, *A*; pl. 17, *A*; pl. 20, *C*).

#### EXTERNAL CHARACTERS

Body rather stout; legs short; tail usually more than half as long as the head and body (about one-third as long in *Citellus madrensis*), distichous, well haired, ears large, rounded on superior margin (height from notch, 13 to 18.5 mm); claws slender, sharp, recurved; thumb rudimentary, bearing a short, broad nail; cheek pouches large; mammae 8 or 10. The color pattern consists of a longitudinal white stripe on each side of the back, bordered on one or both sides with a black stripe.

#### BACULAR CHARACTERS

The baculum is a tiny bone, 2 mm in length, irregularly spatulate in shape. It has been dissected out in only one instance, and may not always be present (pl. 13, *J*).

#### CHIPMUNKS

The chipmunks (genera *Tamias* and *Eutamias*) are more nearly related to the ground squirrels than to the tree squirrels. The essential characters distinguishing these two genera from *Citellus* (including all the subgenera) are as follows: Absence of an antorbital canal, the antorbital foramen being a relatively large opening in the zygomatic process of the maxillary; the anterior border of the zygomatic notch in the maxillary is opposite  $pm^4$  instead of  $m^1$  as in all the ground squirrels; the transverse ridges on  $m^1$  and  $m^2$  are not parallel, the posterior loph being slightly divergent externally.

#### Genus TAMIAS: Eastern Chipmunks

*Tamias* Illiger, Prodrromus Systematis Mammalium et Avium, p. 83, 1811 (type, *Sciurus striatus* Linnaeus).

In general contour the skull of *Tamias* most nearly resembles that of *Citellus* (*Notocitellus*) *annulatus*. It differs from it and from all the ground squirrels in the absence of  $pm^3$ ; in the shape and position of the antorbital foramen; and in the attachment of the anterior root of the zygomata. The posterior border of the zygomatic plate of the maxillary is opposite the extreme posterior part of  $pm^4$  or sometimes the anterior edge of  $m^1$ .

The superior outline of the skull is flat, and the brain case is shallow; the upper incisors are short, moderately stout, and slightly recurved. The molars are low crowned, the cusps wide spaced, with slightly developed subsidiary cusplets between the primary cusps (pl. 15, *B*; pl. 18, *B*; pl. 21, *E*).

The color pattern consists of five blackish and two whitish longitudinal stripes on the dorsal area; a median black stripe is bordered on each side with a broad band of gray or tawny about twice the width of the median stripe; on either side of these dorsal bands are a pair of shorter blackish stripes with a whitish stripe between them.

The baculum of *Tamias striatus* is about 4.5 mm in length, nearly straight, but upturned at the tip and slightly expanded into the shape of a narrow spoon or scoop, with a slight median ridge on the under surface (pl. 13, *A* and *B*).

## Genus EUTAMIAS: Western Chipmunks

*Eutamias* Trouessart, Bull. Soc. d'Etudes Sci. d'Angers 10 (1): 86, 1880 (type, *Sciurus striatus asiaticus* Gmelin).

The western chipmunks are closely related to the eastern chipmunks (*Tamias*). The genus occurs also in eastern Asia, and the American species show some distinctive group characters, considered of subgeneric value.

Compared with *Tamias*, the skull of *Eutamias* has the rostrum shorter and more abruptly constricted at the base; the brain case is smoothly rounded, slightly flattened or moderately inflated; the palate is relatively shorter, terminating on the plane of last molars or but little posterior to it; the notch in the zygomatic plate of the maxillary projects slightly more forward, usually being opposite the middle or posterior part of  $pm^4$ ; the audital bullae are relatively large; the upper incisors show numerous longitudinal striations, which in some species are well-defined grooves; the molariform teeth are much as in *Tamias*, but the anterior premolar ( $pm^3$ ) is always present as a small peglike tooth. The color pattern is distinctive, consisting of five blackish and four whitish longitudinal stripes, all of approximately equal width (pl. 15, *C*; pl. 18, *C*; pl. 21, *H*).

## Subgenus EUTAMIAS

The type of *Eutamias* is *E. asiaticus* of eastern Asia. The cranial characters distinguishing this subgenus from the American subgenus *Neotamias* are as follows: Interorbital constriction slight (as in *Tamias*); postorbital processes broad at base, tapering to a point (much as in *Tamias*); antorbital foramen large, suborbicular (as in *Tamias*); lambdoidal crest moderately developed; upper molariform tooth rows slightly convergent posteriorly (as in *Tamias*); palate short, ending about on plane of last molars. In several of its characters this subgenus resembles *Tamias* more than it does the American *Neotamias*.

The baculum of *E. asiaticus* (one specimen) differs from that of the American species of *Neotamias* in being much more slender. It is 5 mm in length and tapers gradually from base to tip; the distal portion is upturned in an even curve and slightly flattened, but without ridges (pl. 13, *C*).

## Subgenus NEOTAMIAS

*Neotamias* Howell, North Amer. Fauna 52: 26, 1929 (type, *Tamias asiaticus merriami* Allen).

The American members of the genus *Eutamias* present a number of characters distinguishing them from the typical members of the genus, which are confined to Asia. The postorbital processes are narrower at the base and much slenderer throughout; the interorbital constriction is more pronounced; the lambdoidal crest less strongly developed; the antorbital foramen smaller and narrowly oval rather than orbicular; the palate ends slightly posterior to the plane of the last molars; the upper tooth rows are more nearly parallel. The ears are relatively longer and more pointed.

The baculum in the members of this subgenus differs from that of both *Tamias* and typical *Eutamias*; specimens examined of six

species show essential similarity in form but some variation in size. In a specimen of *E. quadrivittatus frater* (pl. 13, *E*), the baculum resembles a human leg in general shape; it is 3.8 mm in length, thickest at the proximal end, and tapers gradually to the tip with a sharp bend in the middle of the shaft; the distal end is bent upward at almost a right angle, expanded and flattened in the shape of a human foot, with a prominent narrow ridge in the center of the "instep." In a specimen of *E. cinereicollis* (pl. 13, *F*) the baculum is 4.7 mm long and the shaft is stouter throughout. Bacula of *E. townsendii sonomae* (pl. 13, *D*) and *E. dorsalis* are about 4.5 mm in length and slenderer than in the other species examined.

### Genus SCIURUS: Tree Squirrels

*Sciurus* Linnaeus, *Systema Naturae* (10) 1: 63, 1758 (type, *Sciurus vulgaris* Linnaeus).

The North American tree squirrels are all remarkably alike in cranial characters, and not widely different from the typical species—*Sciurus vulgaris* of Europe. South America has produced a number of aberrant groups that have been given the rank of genera (Allen, 1915, p. 147). These have not been studied by the writer.

As already pointed out, the tree squirrels are distinguished from the ground squirrels and chipmunks by the great breadth of the interorbital region and the great depth of the brain case; the zygomata are nearly parallel to the axis of the skull and nearly vertical (not twisted as in *Citellus*), with an angular process on the upper surface of the jugal; the antorbital canal is a narrow vertical slit; the upper incisors are compressed laterally and are relatively deep (much like those of *Otospermophilus*). The molars are always low crowned and simple. The anterior upper premolar ( $pm^3$ ) is absent in some groups, present in others, but always very small.

### Subgenus SCIURUS

The typical subgenus is not represented in America.

The skull of the type species—*Sciurus vulgaris* of Europe—is relatively short and broad; the brain case strongly deflected at posterior end; a shallow depression in the anterior frontals with a swelling on posterior frontals; zygomata nearly parallel, moderately expanded; postorbital processes broad at base, tapering abruptly to a long, slender point, depressed and directed backwards; antorbital foramen triangular, broadest at base; notch in maxillary plate of zygoma opposite  $pm^4$ ;  $pm^3$  present, but very small and not rising to the level of  $pm^4$ ;  $pm^4$  subquadrate, narrowest on the inner side (pl. 16, *F*; pl. 19, *F*; pl. 22, *D*).

The baculum of *S. vulgaris*, according to Thomas (1915, p. 384), is essentially like that of *S. carolinensis*.

### Subgenus NEOSCIURUS

*Neosciurus* Trouessart, *Le Naturaliste* 2 (37): 292, October 1880; *Catalogus Mammalium, Rodentia*, p. 76, 1880 (part) (type, *Sciurus carolinensis* Gmelin).

*Echinosciurus* Trouessart, *Idem* (type, *Sciurus hypopyrrhus* Wagler = *S. aureogaster hypopyrrhus*).

*Baiosciurus* Nelson, Wash. Acad. Sci. Proc. 1: 31, May 9, 1899 (type, *Sciurus deppei* Peters).

The skull of *Sciurus carolinensis*—the type of the subgenus *Neosciurus*—does not differ widely in general shape from that of *S. vulgaris* but is relatively longer, with the brain case shallower and more elongated (less globular) and the rostrum longer and relatively narrower; the postorbital processes are shorter and stouter; the notch in the zygomatic plate of the maxillary is opposite  $m^1$  (instead of  $pm^4$ );  $pm^3$  is present but not strongly developed;  $pm^4$  is triangular rather than quadrate in outline, owing to the greater production of the parastyle (pl. 15, *H*; pl. 18, *H*; pl. 21, *F*).

In *S. deppei* (type of *Baiosciurus* Nelson),  $pm^4$  averages slightly more quadrate than the same tooth in *Neosciurus*, but examination of a large series of *deppei* and *carolinensis* shows that the character is too slight and inconstant to serve as a basis for subgeneric distinction.

*Sciurus aureogaster hypopyrrhus* and the large group of Mexican forms associated with it by Nelson in the subgenus *Echinosciurus* differ in general from *S. carolinensis* in having a shorter and relatively broader rostrum and a more or less prominent depression in the frontals; these differences, however, are considered too slight to warrant recognition of the group.

The baculum of *Sciurus carolinensis* is apparently closely similar to that of *Sciurus vulgaris*. It is 10.5 mm in length, the shaft stout, but tapering distally, curved upward near the tip, and flattened into the shape of a shallow scoop with the edges rolled up; on the lower side of the scoop is a small, blunt process (pl. 13, *S*). The baculum of *S. deppei* and that of *S. adolphei dorsalis* (pl. 13, *T*) agree essentially with that of *S. carolinensis*.

The following species are included in *Neosciurus*: *S. carolinensis*, *S. deppei*, *S. aureogaster*, *S. poliopus*, *S. yucatanensis*, *S. colliacii*, *S. truei*, *S. sinaloensis*, *S. nelsoni*, *S. socialis*, *S. griseoflavus*, *S. goldmani*, *S. managuensis*, *S. boothiae*, *S. adolphei*, *S. thomasi*, and *S. variegatoides*.

#### Subgenus HESPEROSCIURUS

*Hesperosciurus* Nelson, Wash. Acad. Sci. Proc. 1: 27, May 9, 1899 (type, *Sciurus griseus* Ord).

The skull of *Sciurus griseus* resembles that of *S. carolinensis* very closely, except that it is larger;  $pm^4$  averages slightly more quadrate (less triangular), but examination of a large series of both species shows the character to be inconstant. The jugal is relatively lighter (shallower) and viewed from beneath shows less twisting from the vertical plane (pl. 15, *G*; pl. 18, *G*; pl. 21, *A*).

The baculum is widely different from that of *Neosciurus*, resembling more closely that of *S. aberti*. The bone measuring 16.5 mm in length, is moderately curved and ends in a blade about 6.8 mm in length, with a curved and slightly twisted edge; the tip of the blade is a blunt point, but at its posterior end it forms a short, sharp hook (pl. 13, *V*).

This subgenus comprises but one species *S. griseus*, of the Pacific coast region of the United States.

## Subgenus OTOSCIURUS

*Otosciurus* Nelson, Wash. Acad. Sci. Proc. 1: 28, May 9, 1899 (type, *Sciurus aberti* Woodhouse).

In general shape the skull of *Sciurus aberti* closely resembles that of *S. vulgaris*;  $pm^3$  is relatively larger and more strongly developed, the crown being subject to wear with the rest of the molar series; the notch in the zygomatic plate of the maxillary is opposite the middle portion of  $m^1$ .

Compared with *Neosciurus*, this subgenus differs in having the brain case and interorbital region relatively broader; postorbital breadth less than the interorbital breadth; postorbital processes larger and longer; postorbital notch deeper;  $pm^3$  more strongly developed (pl. 16, *E*; pl. 19, *E*; pl. 22, *A*).

The baculum is widely different from that of typical *Sciurus* and of *S. carolinensis*, and bears closer resemblance to that of *S. griseus*. It is a nearly straight bone, 16.1 mm in length, the distal portion flattened laterally into the shape of a blade with a curved edge; on the lower side of the blade is a small tubercle (pl. 13, *W*).

The species included in *Otosciurus* are: *S. aberti*, *S. kaibabensis*, *S. concolor*, and *S. durangi*.

## Subgenus PARASCIURUS

*Parasciurus* Trouessart, Le Naturaliste 2 (37): 292, October 1880 (type, *Sciurus niger* Linnaeus).

*Araesciurus* Nelson, Wash. Acad. Sci. Proc. 1: 29, May 9, 1899.

The fox squirrels differ from the other North American squirrels (except *Guerlinguetus*) in the entire absence of  $pm^3$ . Compared with *Neosciurus* the skull is of very similar shape, the brain case somewhat shallower and more flattened; the frontals are slightly elevated on the posterior half; there is a distinct interorbital notch; the notch in the maxillary plate is opposite the middle or hinder part of  $m^1$ ; the molariform teeth are very similar to those of *Neosciurus* (pl. 16, *C*; pl. 19, *C*; pl. 22, *B*).

The baculum is likewise closely similar in shape to that of *Sciurus carolinensis* (pl. 13, *U*).

The subgenus comprises the following species: *S. niger*, *S. arizonensis*, *S. apache*, *S. alleni*, *S. nayaritensis*, and *S. oculus*.

## Subgenus GUERLINGUETUS

*Guerlinguetus* Gray, London Med. Repos. 15: 304, 1821 (type, *Sciurus guerlinguetus* Gray = *S. aestuans* Linnaeus).

*Mesosciurus* Allen, Amer. Mus. Nat. Hist. Bull. 34: 212, 1915.<sup>4</sup>

The skull of *Sciurus aestuans*<sup>5</sup> is similar in shape and size to that of *Tamiasciurus hudsonicus* but has a deeper and more highly arched cranium; the rostrum is short and strongly "pinched in"; the zygomatics are nearly parallel to the axis of the skull; the postorbital processes are short and slender; the hinder portion of the frontals is swollen; the notch in the maxillary plate is opposite the hinder part of  $pm^4$  or the division between this tooth and  $m^1$ ; there is but

<sup>4</sup> Allen proposed *Mesosciurus* as a genus mainly on the possession of eight mammae instead of six, as in *Guerlinguetus*; he states that there is "no very marked difference" in cranial or dental characters between these two groups.

<sup>5</sup> Comparisons were made with a series of skulls from British Guiana, borrowed from the American Museum of Natural History (nos. 34874, 42344, 48137, 48392).

one upper premolar ( $pm^4$ ), which is subcircular or quadrate in shape, differing thus from *Parasciurus* and *Tamiasciurus*, in which this tooth is subtriangular. The skull differs from that of *Parasciurus* also in having a shorter rostrum, more swollen brain case, and in the position of the notch in the maxillary plate of the zygoma (pl. 16, *B*; pl. 19, *B*; pl. 22, *F*.)

The subgenus *Guerlinguetus* is represented in North America by *Sciurus richmondi*, *S. hoffmanni*, and *S. gerrardi*.

#### Genus TAMIASCIURUS: Red Squirrels

*Tamiasciurus* Trouessart. Le Naturaliste 2 (37): 292, October 1880 (type, *Sciurus hudsonicus* Erxleben.)

The red squirrels, or chickarees, differ from typical *Sciurus* in the vestigial character of the anterior upper premolar, which is often absent and when present is minute and never functional, being covered by the crown of  $pm^4$ . The superior outline of the skull is much flatter, the brain case shallower and not strongly deflected posteriorly; the zygomata are less expanded, being parallel to the axis of the skull; the postorbital processes are much shorter.

Compared with *S. (Neosciurus) carolinensis*, *Tamiasciurus* differs in the (usual) absence of  $pm^3$  and in having the notch in the zygomatic plate of the maxillary opposite  $pm^4$  (instead of  $m^1$ ); the rostrum is relatively shorter and broader, and the zygomata less expanded (pl. 16, *D*; pl. 19, *D*; pl. 22, *E*).

Although the red squirrels exhibit no very marked cranial differences from the other tree squirrels, the reproductive tract of the males is strikingly different from that of their relatives in the genus *Sciurus*. They have no baculum, and the penis is long and slender, tapering to a point. The anatomy of *Tamiasciurus hudsonicus*, in comparison with that of certain other sciurids, has been reported on by Mossman et al. (Mossman, Lawlah, and Bradley, 1932, p. 119) and their findings are summarized as follows:

This species differs much more fundamentally from the sciurid type, such as *S. carolinensis*, than any other studied. The striking differences in the male are: minute Cowper's glands opening into the urethra in the bulb, no penile duct, no bulbar gland, a true urethral diverticulum in the bulb, a long filiform penis, and no os penis. The seminal vesicles are excessively large. Anal glands are present. The female also differs from other female Sciuridae examined in having an unusually long, coiled vagina during oestrus.

#### Genus MICROSCIURUS: Pygmy Squirrels

*Microsciurus* Allen, Amer. Mus. Nat. Hist. Bull. 7: 332, Nov. 8, 1895 (type *Sciurus alfari* Allen).

The genus *Microsciurus* comprises the smallest of the North American squirrels. The skull is highly arched, with a pronounced swelling on the frontals at the plane of the postorbital processes; brain case is strongly deflected at posterior end; rostrum is short and broad; upper incisors project forward to or beyond the plane of the tip of nasals; jugal is relatively wide, inferior margin abruptly depressed anteriorly where it joins the maxilla;  $pm^3$  is well developed (pl. 15, *D*; pl. 18, *D*; pl. 21, *B*).

Included in this genus are the species *M. alfari*, *M. boquetensis*, *M. isthmus*, and *M. septentrionalis* in Central America, and others in South America.

**Genus SYNTHEOSCIURUS: Pygmy Squirrels**

*Syntheosciurus* Bangs, Mus. Comp. Zool. Bull. 39: 25, April 1902 (type, *Syntheosciurus brochus* Bangs).

The skull of *Syntheosciurus* is similar to that of *Microsciurus* but with cranium more highly arched; frontals swollen; upper incisors projected forward, and having a broad, shallow groove; molariform teeth relatively large,  $pm^3$  present, reaching the crown of  $pm^4$ ; auditory bullae small; postorbital processes slender.

The fur is woolly; ears short, broad, and densely haired; whiskers rather short; tail round and bushy.

The genus is known only from the type species, occurring in Chiriqui, Panama (pl. 16, A; pl. 19, A; pl. 22, C).

**Genus GLAUCOMYS: Flying Squirrels**

*Glaucomys* Thomas, Ann. and Mag. Nat. Hist. (8) 1: 5, January 1908 (type, *Mus volans* Linnaeus).

The genus *Glaucomys*, which comprises the American flying squirrels, differs widely in cranial characters from all the other groups of the Sciuridae. The skull resembles that of *Sciurus* in the great depth of the brain case and the shape of the zygomata, which are vertical (not twisted as in the ground squirrels); it differs from *Sciurus* in the extreme constriction of the interorbital and postorbital regions and the presence of a deep interorbital notch; the postorbital processes are slender and project about in the middle of the temporal fossa; the incisors are rather slender, and not recurved as in most of the tree squirrels.

The skull agrees with that of the chipmunks (*Eutamias*) in the position of the notch in the maxillary plate of the zygoma, which is opposite  $pm^4$ , but differs from them and agrees with the ground squirrels in the possession of an antorbital canal. The cusps on the outer side of the upper tooth row are higher than in *Sciurus* or *Eutamias* and are without subsidiary cusplets;  $pm^3$  is present and is relatively larger than in *Eutamias*;  $pm^4$  is subquadrate, nearly as large as  $m^1$ , with the parastyle ridge rising to form a cusp; the lower molars resemble those of *Eutamias* in having small cusplets between the primary cusps (pl. 15, A; pl. 18, A; pl. 21, C).

The baculum of *Glaucomys volans* is 12.5 mm in length and relatively much slenderer than in *Sciurus*; the shaft is twisted at the proximal end, and the distal end is bifid; the distal half is compressed on one side into a thin blade reaching to the tip (pl. 13, X).

## REVISION OF THE GENUS CITELLUS

[For generic characters see p. 39]

- Citellus* Oken, Lehrbuch der Zoologie (pt. 3) 2: 842, 1816, (type, *Mus citellus* Linnaeus).
- Anisonyx* Rafinesque, Amer. Monthly Mag. 2 (1): 45, 1817 (type, *Anisonyx brachiura* Rafinesque (= *Arctomys columbianus* Ord)).
- Spermophilus* F. Cuvier, Dents des Mamm., p. 255, 1825, (type, "*Mus citillus* Linn.").
- Spermophila* Richardson, Parry's Second Voyage, App., p. 313, 1825.
- Spermophilus* Cuvier, Dict. Sci. Nat. 59: 473, 1829.
- Spermatophilus* Wagler, Nat. Syst. Amphibien, p. 22, 1830.
- Spermophilis* Richardson, Zool. Voyage H. M. S. "Blossom"; Mamm., p. 12, 1839.
- Citillus* Lichtenstein, Darst. neuer oder wenig bekannt. Säuget., pl 31, fig. 2 (not paged), 1830.
- Colobotis* Brandt, Bull. Class. Phys.-Math. Acad. Imp. Sci. St. Petersburg, 2 (23 and 24): 366, 1844 (type, *Spermophilus fulvus* Lichtenstein).
- Otocolobus* Brandt, *op. cit.*, p. 352 (= *Colobotis*).
- Otospermophilus* Brandt, *op. cit.*, p. 379 (type, *Sciurus grammurus* Say).
- Colobates* Milne-Edwards, Recherches Hist. Nat. Mamm. 1: 157, 1868-74.
- Ictidomys* Allen, Monog. North Amer. Rodentia, p. 821, 1877 (type, *Sciurus tridecemlineatus* Mitchell).
- Xerospermophilus* Merriam, Biol. Soc. Wash. Proc. 7: 27, 1892 (type, *Spermophilus mohavensis* Merriam).
- Ammospermophilus* Merriam, Biol. Soc. Wash. Proc. 7: 27, 1892 (type, *Spermophilus leucurus* Merriam).
- Callospermophilus* Merriam, Biol. Soc. Wash. Proc. 11: 189, 1897 (type, *Sciurus lateralis* Say).
- Ictidomoides* Mearns, U. S. Natl. Mus. Bull. 56: 328, 1907 (type, *Sciurus mcxi-canus* Erxleben).
- Urocitellus* Obolenskij, Comp. Rend. Acad. Sci. URSS., p. 188, 1927 (type, *Spermophilus evermanni* Lichtenstein).

### HISTORY AND NOMENCLATURE

The ground squirrel of central Europe—the ziesel—was mentioned in literature as early as 1551, by Konrad Gesner (p. 835), his account being the principal basis of the Linnaean name *Mus citellus*, the type of the genus *Citellus*.

### GENERIC AND SUBGENERIC NAMES

The ground squirrels were referred by most of the early naturalists to the genus *Arctomys* (= *Marmota*); the name *Spermophilus* was proposed for the group by Cuvier in 1825, but it did not come into general use until about 5 years later. The earlier name *Citellus*, of Oken (1816), was overlooked until revived by Allen in 1902 (p. 373); since then it has been in current use. Rafinesque (1817, p. 45) introduced the name *Anisonyx*, but it was not used by later authors until revived for a short time by Merriam (1895a, p. 18), and later the same year was found to be preoccupied (Merriam, 1895b, p. 107).

The rock squirrels were separated by Brandt (1844, p. 379) as a subgenus—*Otospermophilus*—and they have been regarded since 1907 as a genus by Mearns and certain other writers.

In the same paper, Brandt proposed the subgenus *Colobotis* to include all the Old World species known to him and also *richardsonii*, "hoodii" (= *tridecemlineatus*), and *franklinii* of North America. The type is *Spermophilus fulvus* Lichtenstein, of southern Russia. The name *Colobotis* has been used in a subgeneric sense by several modern authors without any definite idea of its correct application, due to the lack of material representing the type species. Recently, through the kindness of L. R. Dice, opportunity has been afforded to examine a single skull of *Citellus fulvus* (pls. 14, 17, 20) from Turkestan (no. 57827, Univ. Mich. Mus. Zool.), and this proves to agree in essential characters with *Citellus parryii ablusus*, and so far as can be determined from a single specimen it does not differ in any character of generic value from *C. citellus*, the type of the genus.

The only character of importance distinguishing the skull of *Citellus fulvus* from that of *C. citellus* (pls. 14, 17, 20) appears to be the presence on the former of a well-defined metaloph on  $m^3$ ; this loph is absent on the series of 12 adult skulls of *C. citellus* from Hungary, but is faintly developed on a single young individual from the same region. Unfortunately, no young skulls of *C. fulvus* are available, and it is quite possible that the metaloph of  $m^3$  may vary in the extent of its development, as it does in numerous North American species.

Of the North American species, those in which the metaloph on  $m^3$  is most strongly developed are *C. parryii*, *C. osgoodi*, *C. columbianus*, *C. richardsonii*, *C. armatus*, and *C. washingtoni*. In *C. townsendii mollis* and *C. idahoensis*, this loph is absent or very slightly developed, while in *C. beldingi* it is sometimes present, sometimes absent.

In consideration of the great variability of this character in the American species, and in the absence of any definite group characters, it is considered inadvisable to recognize *Colobotis* as a subgenus.

Allen (1877, p. 821) established the subgenus *Ictidomys*, but without naming a type; Merriam (Allen, 1895a, p. 418) fixed the type as *Citellus tridecemlineatus*. Merriam (1892, p. 27) already had established the subgenus *Xerospermophilus*, with *Spermophilus mohavensis* as type, and the subgenus *Ammospermophilus* for the antelope ground squirrels, using as type, *Spermophilus leucurus*. The latter group since 1905 has been accorded generic rank by most authors. In the present study it is again reduced to subgeneric rank, as is also *Callospermophilus*, proposed by Merriam in 1897 (p. 189) as a subgenus to include the mantled ground squirrels, and since regarded as a genus by many authors.

Mearns (1907, p. 328) proposed the name *Ictidomoides* as a subgenus for the species *Citellus mexicanus*, but this is now considered the same as *Ictidomys*.

Obolenskij (1927, p. 188) has proposed *Urocitellus* as a subgenus, with *C. eversmanni* as the type, but this species shows no cranial characters to separate it from typical *Citellus*.

The first two North American species to be recognized were *Citellus mexicanus* and *C. variegatus*, both described by Erxleben in 1777, and referred to the genus *Sciurus*. The former name was adopted by later writers, but the latter was allowed to lapse, through failure to distinguish the animal to which it was applied, for more than a

century, when Nelson (1898, p. 898) reinstated it by showing its applicability to the Mexican rock squirrel, then commonly referred to under the name *Spermophilus macrourus*.

A similar fate was in store for the Columbian ground squirrel, first described by Lewis and Clark and named *Arctomys columbianus* in 1815 by Ord (pp. 292, 303), and again in 1817, *Anisonyx brachyura*, by Rafinesque (p. 45). Baird (1875, p. 336) discussed the possibility that this animal might be a prairie dog—the same as his *Cynomys gunnisoni*—but he pointed out certain important differences. Allen, however (1877, p. 903), unhesitatingly pronounced it a prairie dog and it was so considered until Merriam (1891, p. 39), having procured specimens from the type region, showed it to be a ground squirrel.

The next species to be described was the striped ground squirrel, named *Sciurus tridecemlineatus* by Mitchill in 1821. The following year, Sabine renamed this animal *hoodii* and described also two other species, the Franklin's and Richardson's ground squirrels, all referred by him to the genus *Arctomys*.

Long's expedition to the Rocky Mountains in 1819–20 resulted in the discovery of two new species, *Citellus grammurus* and *C. lateralis*, both described by Say in 1823 in the genus *Sciurus*.

Richardson, in 1825, described the big northern ground squirrel, *C. parryii*, in the genus *Arctomys*, and in 1829, two supposed new varieties of that species, *erythrogluteia* and *phaeognatha*; *erythrogluteia* later proved to be a synonym of *columbianus* and *phaeognatha* a synonym of *parryii*. The same year he named two species from the west coast region, *beecheyi* and *douglasii*.

In 1833, Bennett described the Mexican spotted ground squirrel, *C. spilosoma*, and the Mexican rock squirrel under the name *Spermophilus macrourus*; the latter name, however, was later found to be a synonym of *C. variegatus*.

Bachman, in 1839, described *Citellus townsendii* from the plains of the Columbia, but the type specimen soon became so discolored with grease that its true characters could not be seen, and as a result the name *townsendii* has been misapplied by most recent authors (see explanation on p. 62).

Audubon and Bachman, in 1842, described *Spermophilus* (= *Citellus*) *annulatus*, and in 1854, *S. harrisii*—both from unknown localities—and in 1855, Baird added *S. couchii* from northern Mexico.

Thus, when Baird's monograph appeared in 1857, there had been described 16 valid races of ground squirrels from North America, and of these all but three were treated in the monograph. *Spermophilus annulatus* was thought to be an African species of *Sciurus*; *S. macrourus* of Bennett (= *Citellus variegatus*) was provisionally included, while Ord's *Arctomys columbianus* was doubtfully referred to as a prairie dog. Baird added in this paper one new species—the round-tailed spermophile of the Southwest—*Spermophilus tereticaudus*.

In 1861, Ross named a form of Parry's spermophile, *Arctomys kennicottii* (not now recognized), and Slack described the black rock squirrel of Texas, *Spermophilus buckleyi*. Kennicott, in 1863, described four new forms, all of which are now recognized as valid: *Spermophilus mollis*, *S. armatus*, *S. elegans*, and *S. obsoletus*.

J. A. Allen added *Spermophilus parryi kodiacensis* in 1874 and *S. tridecemlineatus pallidus* in 1877. In his Monograph of the Rodentia (1877) 17 forms were treated, only three more than appeared in Baird's monograph issued 20 years earlier. *Spermophilus townsendii* was considered to be a variety of *richardsonii*, whereas *elegans* and *armatus* were both listed in the synonymy of that species. Parry's spermophile appeared under the name of *S. empetra*, while *S. harvisii* and *S. lateralis* were transferred to the genus *Tamias*.

No more new species were described until 1888, when Merriam named *Spermophilus beldingi*. Shortly after this, the modern period of activity in systematic mammalogy began, initiated largely by the extensive researches and explorations of Merriam and his collectors in the Biological Survey. At the beginning of this period, 1889, 30 forms of North American ground squirrels had been named, of which 25 are now considered valid races. Since that time, 91 additional forms have been named, of which 69 are considered valid; three new races are named in the present paper, making a total of 97 recognized races.

## KEY TO SUBGENERA

- a*<sup>1</sup>. Molars relatively hypsodont; parastyle ridge on *m*<sup>1</sup> and *m*<sup>2</sup> joining the protocone with an abrupt change of direction.
- b*<sup>1</sup>. Metaloph on *pm*<sup>4</sup> continuous----- *Citellus* (p. 59)
- b*<sup>2</sup>. Metaloph on *pm*<sup>4</sup> not continuous----- *Ictidomys* (p. 106)
- a*<sup>2</sup>. Molars relatively brachydont; parastyle on *m*<sup>1</sup> and *m*<sup>2</sup> rising evenly to join the protocone, without abrupt change of direction.
- b*<sup>1</sup>. Anterior upper premolar simple; less than one-fourth the size of *pm*<sup>4</sup>.
- c*<sup>1</sup>. Upper incisors relatively stout and distinctly recurved.
- d*<sup>1</sup>. Brain case rounded on upper surface.
- e*<sup>1</sup>. Supraorbital foramen open----- *Otospermophilus* (p. 135)
- e*<sup>2</sup>. Supraorbital foramen closed----- *Notocitellus* (p. 162)
- d*<sup>2</sup>. Brain case flattened on upper surface----- *Ammospermophilus* (p. 166)
- c*<sup>2</sup>. Upper incisors relatively slender, not distinctly recurved.
- d*<sup>1</sup>. Postorbital processes long and slender; rostrum longer----- *Callospermophilus* (p. 190)
- d*<sup>2</sup>. Postorbital processes short and stout; rostrum shorter----- *Xerospermophilus* (p. 183)
- b*<sup>2</sup>. Anterior upper premolar bearing two cusps and a functional cutting edge; more than one-fourth the size of *pm*<sup>4</sup>----- *Poliocitellus* (p. 133)

## LIST OF SPECIES AND SUBSPECIES, WITH TYPE LOCALITIES

## Subgenus CITELLUS Oken

## CITELLUS TOWNSENDII GROUP

- Citellus townsendii townsendii* (Bachman)----- Columbia River, near mouth of Walla Walla River, Washington.
- townsendii canus* (Merriam)----- Antelope, Oregon.
- townsendii vigilis* Merriam----- Vale, Oregon.
- townsendii mollis* (Kennicott)----- Camp Floyd, near Fairfield, Utah.
- townsendii artemesiae* Merriam----- Birch Creek, Idaho.
- idahoensis* (Merriam)----- Payette, Idaho.

## CITELLUS WASHINGTONI GROUP

<i>Citellus washingtoni washingtoni</i> , nobis.....	Touchet, Washington.
<i>washingtoni loringi</i> , nobis.....	Douglas, Washington.
<i>brunneus</i> Howell.....	New Meadows, Idaho.

## CITELLUS RICHARDSONII GROUP

<i>Citellus richardsonii richardsonii</i> (Sabine).....	Carlton House, Saskatchewan.
<i>richardsonii elegans</i> (Kennicott).....	Fort Bridger, Wyoming.
<i>richardsonii nevadensis</i> Howell.....	Paradise, Nevada.
<i>armatus</i> (Kennicott).....	Fort Bridger, Wyoming.
<i>beldingi beldingi</i> (Merriam).....	Donner, California.
<i>beldingi oregonus</i> (Merriam).....	Swan Lake Valley, Oregon.

## CITELLUS PARRYII GROUP

<i>Citellus columbianus columbianus</i> (Ord).....	Camas prairie, between the forks of the Clearwater and Kooskooskie Rivers, Idaho.
<i>columbianus ruficaudus</i> Howell.....	Wallowa Lake, Oregon.
<i>parryii parryii</i> (Richardson).....	Lyon Inlet, Melville Peninsula, Canada.
<i>parryii barrowensis</i> (Merriam).....	Point Barrow, Alaska.
<i>parryii plesius</i> (Osgood).....	Bennett City, British Columbia.
<i>parryii ablusus</i> Osgood.....	Nushagak, Alaska.
<i>parryii nebulicola</i> Osgood.....	Nagai Island, Shumagin Islands, Alaska.
<i>parryii lyratus</i> Hall and Gilmore.....	St. Lawrence Island, Alaska.
<i>kodiakensis</i> (Allen).....	Kodiak Island, Alaska.
<i>osgoodi</i> (Merriam).....	Fort Yukon, Alaska.

## Subgenus ICTIDOMYS Allen

## CITELLUS TRIDECEMLINEATUS GROUP

<i>Citellus tridecemlineatus tridecemlineatus</i> (Mitchill).....	Central Minnesota.
<i>tridecemlineatus texensis</i> (Merriam).....	Gainesville, Texas.
<i>tridecemlineatus arenicola</i> Howell.....	Pendennis, Kansas.
<i>tridecemlineatus pallidus</i> (Allen).....	Yellowstone River (mouth), Montana.
<i>tridecemlineatus alleni</i> (Merriam).....	Bighorn Mountains, Wyoming.
<i>tridecemlineatus hollisteri</i> Bailey.....	Sacramento Mountains, New Mexico.
<i>tridecemlineatus monticola</i> Howell.....	White Mountains, Arizona.
<i>tridecemlineatus parvus</i> (Allen).....	Uncompahgre Indian Reservation, Utah.
<i>mexicanus mexicanus</i> (Erxleben).....	Toluca, Mexico.
<i>mexicanus parvidens</i> (Mearns).....	Fort Clark, Texas.

## CITELLUS SPILOSOMA GROUP

<i>Citellus spilosoma spilosoma</i> (Bennett).....	Durango, Mexico.
<i>spilosoma pallescens</i> Howell.....	La Ventura, Coahuila.
<i>spilosoma canescens</i> (Merriam).....	Willecox, Arizona.
<i>spilosoma major</i> (Merriam).....	Albuquerque, New Mexico.
<i>spilosoma annectens</i> (Merriam).....	Padre Island, Texas.
<i>spilosoma pratensis</i> (Merriam).....	San Francisco Mountain, Arizona.
<i>spilosoma cryptospilotus</i> (Merriam).....	Painted Desert, Arizona.
<i>spilosoma obsoletus</i> (Kennicott).....	Western Nebraska.
<i>perotensis</i> (Merriam).....	Perote, Veracruz.

## Subgenus POLIOCITELLUS, nobis

<i>Citellus franklinii</i> (Sabine).....	Carlton House, Saskatchewan.
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## Subgenus OTOSPERMOPHILUS Brandt

<i>Citellus variegatus variegatus</i> (Erxleben).....	Valley of Mexico, Mexico.
<i>variegatus rupestris</i> Allen.....	Rio Sestin, Durango.
<i>variegatus couchii</i> (Baird).....	Santa Catarina, Nuevo Leon.
<i>variegatus buckleyi</i> (Slack).....	Packsaddle Mountain, Texas.
<i>variegatus grammurus</i> (Say).....	Purgatory River, Colorado.
<i>variegatus tularosae</i> Benson.....	Carrizozo, New Mexico (12 mi. northwest).
<i>variegatus utah</i> Merriam.....	Ogden, Utah.
<i>beecheyi beecheyi</i> (Richardson).....	San Francisco and Monterey, California (neighborhood of).
<i>beecheyi douglasii</i> (Richardson).....	Lower Columbia River, Oregon.
<i>beecheyi sierrae, nobis</i> .....	Lake Tahoe, California.
<i>beecheyi fisheri</i> (Merriam).....	Onyx, California.
<i>beecheyi parvulus</i> Howell.....	Argus Mountains, California.
<i>beecheyi nudipes</i> Huey.....	Hanson Laguna, Baja California.
<i>beecheyi rupinarum</i> Huey.....	Catavina, Baja California.
<i>beecheyi nesioticus</i> Elliot.....	Catalina Island, California.
<i>atricapillus</i> (Bryant).....	Comondú, Baja California.

## Subgenus NOTOCITELLUS, nobis

<i>Citellus annulatus annulatus</i> (Audubon and Bachman).....	Manzanillo, Colima.
<i>annulatus goldmani</i> (Merriam).....	Santiago, Nayarit.
<i>adocetus</i> Merriam.....	La Salada, Michoacan.

## Subgenus AMMOSPERMOPHILUS Merriam

<i>Citellus harrisi harrisi</i> (Audubon and Bachman).....	Santa Cruz Valley, Arizona.
<i>harrisi saxicola</i> (Mearns).....	Tinajas Altas, Arizona.
<i>leucurus leucurus</i> (Merriam).....	San Gorgonio Pass, California.
<i>leucurus tersus</i> (Goldman).....	Prospect Valley, Grand Canyon, Arizona.
<i>leucurus cinnamomeus</i> (Merriam).....	Painted Desert, Arizona.
<i>leucurus pennipes</i> (Howell).....	Grand Junction, Colorado.
<i>leucurus peninsulae</i> (Allen).....	San Telmo, Baja California.
<i>leucurus canfieldae</i> (Huey).....	Punta Prieta, Baja California.
<i>leucurus extimus</i> (Nelson and Goldman).....	Saccaton, Baja California.
<i>interpres</i> (Merriam).....	El Paso, Texas.
<i>insularis</i> (Nelson and Goldman).....	Espiritu Santo Island, Baja California.
<i>nelsoni</i> (Merriam).....	Tipton, California.

## Subgenus XEROSPERMOPHILUS Merriam

<i>Citellus mohavensis</i> (Merriam).....	Hesperia, California (15 mi. east).
<i>tereticaudus tereticaudus</i> (Baird).....	Old Fort Yuma, California.
<i>tereticaudus neglectus</i> (Merriam).....	Dolan Spring, Arizona.
<i>tereticaudus chlorus</i> Elliot.....	Palm Springs, California.
<i>tereticaudus apricus</i> Huey.....	Trinidad Valley, Baja California.

## Subgenus CALLOSPERMOPHILUS Merriam

<i>Citellus lateralis lateralis</i> (Say).....	Canon City, Colorado.
<i>lateralis wortmani</i> (Allen).....	Bitter Creek, Wyoming.
<i>lateralis arizonensis</i> (Bailey).....	San Francisco Mountain, Arizona.
<i>lateralis caryi</i> (Howell).....	Wind River Mountains, Wyoming.
<i>lateralis cinerascens</i> (Merriam).....	Helena, Montana.
<i>lateralis tesorum</i> (Hollister).....	Smoky River (head), Alberta.
<i>lateralis castanurus</i> (Merriam).....	Fort Klam, Utah.
<i>lateralis chrysodeirus</i> (Merriam).....	Fort Klamath, Oregon.
<i>lateralis connectens</i> (Howell).....	Homestead, Oregon.
<i>lateralis trepidus</i> (Taylor).....	Pine Forest Mountains, Nevada.

<i>Citellus lateralis certus</i> (Goldman).....	Charleston Peak, Nevada.
<i>lateralis bernardinus</i> (Merriam).....	San Bernardino Peak, California.
<i>lateralis miltatus</i> (Howell).....	South Yolla Bolly Mountain, California.
<i>lateralis trinitatis</i> (Merriam).....	Trinity Mountains, California.
<i>saluratus</i> (Rhoads).....	Lake Keechelus, Washington.
<i>madrensis</i> (Merriam).....	Sierra Madre, Chihuahua.

## EXPLANATION OF CRANIAL MEASUREMENTS

Measurements of the skulls of *Citellus* have been taken in millimeters, as follows:

*Greatest length*.—From anterior border of nasals to posterior border of supra-occipital in median line.

*Palatilar length*.—From posterior border of upper incisors to posterior border of palate (disregarding median process).

*Zygomatic breadth*.—Greatest breadth across zygomata.

*Cranial breadth*.—Least breadth of cranium measured just behind the zygomata.

*Interorbital breadth*.—Least breadth across frontals in front of postorbital processes.

*Postorbital constriction*.—Least breadth across frontals behind postorbital processes.

*Length of nasals*.—Greatest length of nasals, measured along median line.

*Maxillary tooth row*.—Alveolar length of maxillary molar-premolar tooth row.

## Subgenus CITELLUS Oken

[For subgeneric characters, see p. 40].

## KEY TO SPECIES AND SUBSPECIES

- a*<sup>1</sup>. Upper parts unspotted.
- b*<sup>1</sup>. Hind foot more than 39 mm.
- c*<sup>1</sup>. Under side of tail grayish..... *armatus* (p. 78)
- c*<sup>2</sup>. Under side of tail buffy or reddish.
- d*<sup>1</sup>. Under side of tail buffy.
- e*<sup>1</sup>. Upper parts more buffy..... *richardsonii* (p. 73)
- e*<sup>2</sup>. Upper parts more grayish..... *elegans* (p. 76)
- d*<sup>2</sup>. Under side of tail reddish.
- e*<sup>1</sup>. Upper parts mainly reddish..... *beldingi* (p. 81)
- e*<sup>2</sup>. Upper parts mainly grayish.
- f*<sup>1</sup>. Under side of tail hazel..... *oregonus* (p. 83)
- f*<sup>2</sup>. Under side of tail sayal brown..... *nevadensis* (p. 77)
- b*<sup>2</sup>. Hind foot less than 39 mm.
- c*<sup>1</sup>. Size large (average length about 246 mm); upper parts dappled..... *idahoensis* (p. 68)
- c*<sup>2</sup>. Size smaller (average length about 226 mm); upper parts plain.
- d*<sup>1</sup>. Size smaller (skull length, 32.4–35.3)..... *artemesiae* (p. 65)
- d*<sup>2</sup>. Size larger (skull length, 34.6–39.6).
- e*<sup>1</sup>. Upper parts mainly grayish.
- f*<sup>1</sup>. Tail longer (44–61 mm)..... *mollis* (p. 63)
- f*<sup>2</sup>. Tail shorter (37–42 mm)..... *canus* (p. 67)
- e*<sup>2</sup>. Upper parts mainly buffy.
- f*<sup>1</sup>. Skull larger (37.3–39.6 mm); color paler..... *vigilis* (p. 66)
- f*<sup>2</sup>. Skull smaller (37–38.7 mm); color darker..... *townsendii* (p. 60)
- a*<sup>2</sup>. Upper parts spotted or mottled.
- b*<sup>1</sup>. Size larger (hind foot more than 40 mm).
- c*<sup>1</sup>. Dorsal spots whitish.
- d*<sup>1</sup>. Hind feet darker (hazel)..... *osgoodi* (p. 104)

- a*<sup>2</sup>. Upper parts spotted or mottled—Continued.
- b*<sup>1</sup>. Size larger (hind foot more than 40 mm)—Continued.
- c*<sup>1</sup>. Dorsal spots whitish—Continued.
- d*<sup>2</sup>. Hind feet paler (cinnamon, buff, or clay color).
- e*<sup>1</sup>. Tail shorter (77–82 mm)----- *nebulicola* (p. 100)
- e*<sup>2</sup>. Tail longer (81–138 mm).
- f*<sup>1</sup>. Dorsal spots smaller.
- g*<sup>1</sup>. Tail darker (more blackish) above, paler beneath----- *kodiacensis* (p. 103)
- g*<sup>2</sup>. Tail paler above, darker beneath----- *plesius* (p. 97)
- f*<sup>2</sup>. Dorsal spots larger.
- g*<sup>1</sup>. Under parts darker in summer pelage (ochraceous tawny)----- *parryii* (p. 91)
- g*<sup>2</sup>. Under parts paler in summer pelage (cinnamon buff).
- h*<sup>1</sup>. Size larger (skull length, 58–62.8 mm)----- *barrowensis* (p. 95)
- h*<sup>2</sup>. Size smaller (skull length, 54–58.8 mm).
- i*<sup>1</sup>. Upper parts brownish----- *ablusus* (p. 98)
- i*<sup>2</sup>. Upper parts grayish----- *lyratus* (p. 101)
- c*<sup>2</sup>. Dorsal spots buffy.
- d*<sup>1</sup>. Tail mainly grayish above----- *columbianus* (p. 85)
- d*<sup>2</sup>. Tail mainly reddish above----- *ruficaudus* (p. 89)
- b*<sup>2</sup>. Size smaller (hind foot less than 40 mm).
- c*<sup>1</sup>. Upper parts grayish.
- d*<sup>1</sup>. Size larger (hind foot, 34–38 mm)----- *washingtoni* (p. 69)
- d*<sup>2</sup>. Size smaller (hind foot, 30–33 mm)----- *loringi* (p. 71)
- c*<sup>2</sup>. Upper parts brownish----- *brunneus* (p. 72)

## CITELLUS TOWNSENDII GROUP

## CITELLUS TOWNSENDII (BACHMAN)

[Synonymy under subspecies]

*Specific characters*.—Size small; hind foot 29–36 mm; tail 32–61; skull length 32.4–39.6. Skull relatively short and broad; zygomata heavy and rather widely expanded; rostrum stout, its sides nearly parallel; supraorbital borders slightly elevated; postorbital processes long, slender, decurved; brain case broad; temporal ridges lyrate, meeting posteriorly in old age to form a slight crest; audital bullae moderately inflated, the meatus rather long; molars hypsodont; upper incisors rather slender. Coloration plain, smoke gray, shaded with pinkish buff or pinkish cinnamon; tail cinnamon drab, sayal brown, or clay color.

## CITELLUS TOWNSENDII TOWNSENDII (BACHMAN)

## TOWNSEND'S GROUND SQUIRREL

*Spermophilus townsendii* Bachman, Jour. Acad. Nat. Sci. Phila. 8: 61, 1839;

Townsend, Narr. Jour. Rocky Mountains to Columbia River, etc., p. 316, 1839.

*Spermophilus mollis yakimensis* Merriam, Biol. Soc. Wash. Proc. 12: 70, Mar. 24, 1898.

[*Citellus mollis*] *yakimensis* Trouessart, Cat. Mamm., Sup., p. 339, 1904.

*Type*.—Collected "on the Columbia River, about 300 miles above its mouth" [near the mouth of Walla Walla River, Wash.], in July 1836, by J. K. Townsend; mounted specimen no. 344, collection Acad. Nat. Sci. Philadelphia.

*Range*.—South-central Washington, between the Columbia River and the Cascade Range, north to Ellensburg (fig. 1). *Zonal range*: Upper Sonoran.

*External characters.*—Similar in color to *C. t. canus* and *C. t. vigilis* but averaging more buffy or brownish (less grayish) above; tail and hind feet longer than in *canus*.

*Cranial characters.*—Skull similar to that of *canus* but averaging longer (actually and relatively), with decidedly longer nasals and tooth row, and larger audital bullae.

*Color.*—*Winter pelage* (March): Upper parts smoke gray, shaded with pinkish buff; patch on front of face cinnamon; sides of face and head smoke gray; sides of body faintly washed with pinkish

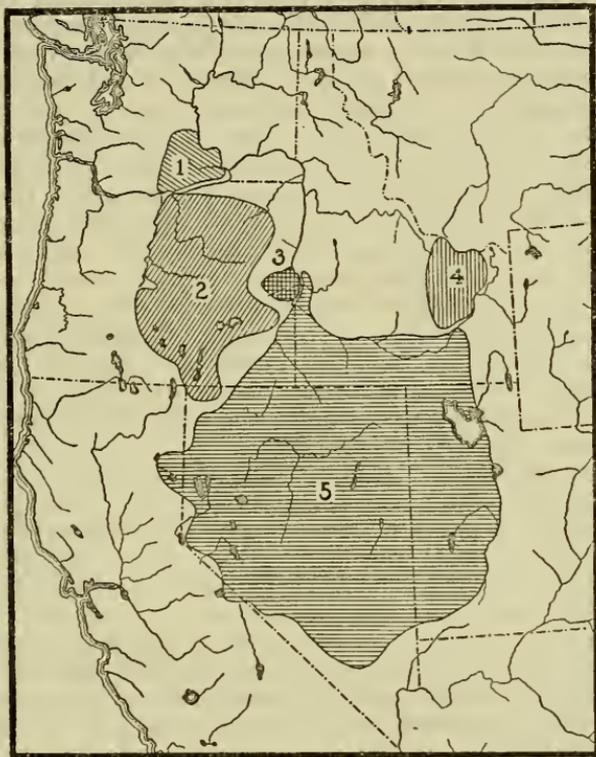


FIGURE 1.—Distribution of the subspecies of *Citellus townsendii*: 1, *C. t. townsendii*; 2, *C. t. canus*; 3, *C. t. vigilis*; 4, *C. t. artemesiaca*; 5, *C. t. mollis*.

buff; thighs cinnamon; feet pinkish buff; tail cinnamon or sayal brown, shaded with fuscous and edged with buffy white or pinkish buff; under parts creamy white, washed with pinkish buff. *Worn summer pelage* (July 16): Paler and more grayish than in winter and not appreciably different from *canus* at that season.

*Variation.*—A single specimen in a series of 14 taken in March at Ellensburg and Yakima is decidedly darker than the rest, the upper parts being uniform pale snuff brown.

*Measurements.*<sup>o</sup>—Average of 10 adults from Mabton and North Yakima, Wash.: Total length, 212.2 (200–232); tail vertebrae, 45.7 (39–54); hind foot, 33.9 (32–37). *Skull*: Average of 10 adults from Mabton, Bickleton, and North Yakima: Greatest length, 37.9 (37.1–38.7); palatilar length, 17.9 (17.3–18.2); zygomatic breadth, 24 (23.3–25.1); cranial breadth 17.9 (17.4–18.4);

<sup>o</sup> All measurements are in millimeters (see p. 59).

interorbital breadth, 7.5 (7-8.2); postorbital constriction, 10.3 (9.4-10.9); length of nasals, 14.5 (13.2-15.7); maxillary tooth row, 8.2 (8-8.5).

*Remarks.*—This species, although first recognized nearly 100 years ago, remained imperfectly known for most of that period and at the present time the name *townsendii* is currently applied to another species (here described under the name *Citellus washingtoni*). The type specimen was collected by J. K. Townsend, "on the Columbia River, about 300 miles above its mouth, in July" 1836 (Townsend, 1839, p. 316). Bachman (1839, p. 61), in the original description, states that Townsend informed him that the species inhabits "the prairies near the Walla-walla." It so happens that in the section along the Columbia River at the mouth of the Walla Walla River two species of ground squirrels occur—a plain-colored form on the west side of the river and a spotted species on the east side. Townsend does not state on which side of the river his specimen was taken.

Fortunately, the type specimen has been preserved in the collection of the Academy of Natural Sciences of Philadelphia (no. 344), and through the courtesy of the authorities of that institution the writer has been able to examine and compare it with modern specimens. The type specimen had been mounted with the skull inside and in the course of years it has become so covered with grease and dirt as to be almost unrecognizable. After being immersed for several days in petroleum ether, however, the grease has largely been removed and the animal is seen to lack the conspicuous buffy white spots of the species living on the east side of the Columbia, currently known under the name *Citellus townsendii*.

A brief review of the history of this name will assist in clearing up the misunderstanding as to its allocation. In the original description no mention is made of dorsal spotting, but in Audubon and Bachman (1854, p. 226) the description of this species includes a statement that it is "speckled with white all over the back." This, however, apparently does not mean that it is spotted, for on page 228 the authors say that they compared a specimen with the European *Spermophilus guttatus*—a coarsely spotted species—and found it very different. "They may be distinguished from each other at a glance by the large rounded spots on the back of the Russian animal, compared with the white and irregular specks in the American species."

J. A. Allen, in a paper listing the species and varieties of the North American Sciuridae (1874, p. 293), correctly associated *townsendii* with *Spermophilus mollis*, but in his monograph of the group (1877, pp. 848-854) he transferred the name to the form described by Kennicott in 1863 as *S. elegans*, listing it as a variety of *S. richardsoni*.

Merriam (1891, p. 36) showed that Allen's assignment of the name to *elegans* was wrong, and applied it to the small unspotted ground squirrel of southern Idaho, listing *S. mollis* as a possible subspecies of the same group.

Twenty-two years later (1913, p. 137) Merriam described this Idaho race under the name *C. mollis artemesiae*, but failed to associate it with *townsendii*, as he had previously done.

In May 1891 a collector from the Biological Survey obtained a series of the spotted ground squirrels from Pasco and Touchet,

Wash., and on the assumption that they came from the type region of *townsendii*, they were referred to that species and so labeled in the Biological Survey collection. Now, however, since the type specimen of *townsendii* proves to be unspotted, and agrees in size and general coloration with the species living on the west side of the Columbia River, it becomes necessary to transfer the name *townsendii* to that race now known as *Citellus mollis yakimensis*.

This race is apparently isolated by the Columbia River from the other races of *townsendii*; it is most nearly related to *canus* but is decidedly more brownish, especially in winter pelage. Contrary to the usual condition in this group the winter pelage is more brownish (less grayish) than the summer pelage.

*Specimens examined*.—Total number, 33, as follows:

**Washington:** Bickleton, 3; Columbia River Valley (20 miles south of Priest Rapids), 1; Ellensburg, 8; Kiona (Benton County), 2;<sup>7</sup> Mabton, 9; North Yakima, 3; Wiley City, 6; Yakima, 1.<sup>7</sup>

#### CITELLUS TOWNSENDII MOLLIS (KENNICOTT)

##### PIUTE GROUND SQUIRREL

(Pls. 1; 23, A; 28, A)

*Spermophilus mollis* Kennicott, Acad. Nat. Sci. Phila. Proc. 1863: 157.

[*Spermophilus townsendii*] var. *mollis* Allen, Boston Soc. Nat. Hist. Proc. 16: 293, 1874.

*Spermophilus mollis stephensi* Merriam, Biol. Soc. Wash. Proc. 12: 69, 1898. (Queen Station, near head of Owens Valley, Nev.)

[*Citellus*] *mollis* Trouessart, Cat. Mamm., Sup., p. 339, 1904.

*Citellus leurodon* Merriam, Biol. Soc. Wash. Proc. 26: 136, 1913. (Murphy, Idaho.)

*Citellus mollis washoensis* Merriam, Biol. Soc. Wash. Proc. 26: 138, 1913. (Carson Valley, Nev.)

*Type*.—Collected at Camp Floyd, near Fairfield, Utah, March 18, 1859, by C. S. McCarthy; skin and skull, no.  $\frac{3}{4}77\frac{7}{8}$ , U. S. Natl. Mus. (orig. no. 164.)

*Range*.—Western Utah, southern Idaho, Nevada, and southeastern Oregon; north to Pocatello and Weiser, Idaho, and Rome, Oreg.; east to Salt Lake City and Manti, Utah; south to Cedar City, Utah, and Clark County, Nev.; west to Carson, Nev., and Honey Lake and Owens Valley, Calif. (fig. 1). *Zonal range*: Upper Sonoran.

*External characters*.—Smaller and paler than *C. idahoensis*; color plain smoke gray, without distinct dappling; tail paler and less bushy.

*Cranial characters*.—Skull about the size of that of *C. washingtoni washingtoni*; in comparison with that of the other races of *C. townsendii*, relatively long and narrow, the zygomata not wide spreading; rostrum and nasals long, the nasals ending posteriorly on a line with the premaxillae or beyond them.

*Color*.—*Gray phase* (Fairfield, Utah, June 28): Upper parts uniform smoke gray (a subterminal band of snuff brown or bister on the body hairs, in worn pelage, lends a brownish cast to the general tone, with a suggestion of "dappling"); nose and front of face cinnamon or clay color; sides of head and body often more or less washed with pinkish buff; eyelids creamy white or pinkish buff;

<sup>7</sup> Univ. Michigan Mus. Zool.

front feet pinkish buff; hind feet grayish white, sometimes washed with pinkish cinnamon; thighs usually strongly washed with pinkish cinnamon; tail above and below smoke gray, strongly shaded with cinnamon or snuff brown, especially on distal portion, and edged with white; under parts creamy white, washed with pinkish buff. *Buff phase*: Similar to the gray phase but entire upper parts strongly washed with pinkish buff.

*Molt*.—In the series examined there is no clear indication of when or how the molt takes place; numerous specimens taken in the latter half of May and early in June are in badly worn pelage, which would indicate that the molt may occur in June or July.

*Measurements*.—Average of 12 (ad. and subad.) from Fairfield, Utah: Total length, 213.1 (201–233); tail vertebrae, 52 (44–61); hind foot, 33.7 (31–36). *Skull*: Average of 15 (ad. and subad.) from Fairfield, Nephi, Salt Lake City, and Promontory, Utah: Greatest length, 37.5 (36.1–39.3); palatilar length, 18.2 (17–19); zygomatic breadth, 23.8 (22.7–25.7); cranial breadth, 17.4 (16.4–18.5); interorbital breadth, 7.7 (6.5–8.5); postorbital constriction, 10 (9.2–10.7); length of nasals, 13.2 (12.6–14.4); maxillary tooth row, 8.2 (7.5–8.5).

*Weight*.—Two females from White Horse Sink, Oreg., weighed 8 ounces each.

*Remarks*.—The Piute ground squirrel is widely distributed in the Great Basin and has been known for many years. In southeastern Idaho it grades into the smaller race *C. t. artemesiae*. A single specimen from Disaster Peak, Oreg., agrees with *mollis* in color but in skull characters resembles *C. t. canus*.

A considerable series from southern Nevada, including topotypes of the form "*stephensi*", prove to be not appreciably different from typical *mollis*.

The form described from Murphy, Idaho, under the name "*leurodon*" seems clearly referable to typical *mollis*; the skull of the type may be closely matched by specimens from Utah, and the average skull measurements of a series of "*leurodon*" show no important differences by which they could be separated from *mollis*.

The form described from Carson Valley, Nev., as "*washoensis*" is slightly darker than typical *mollis*; the skull of the type is from a very old and abnormally large individual, but that of another adult male in the series is closely matched by specimens of *mollis* from Salt Lake City, Utah; therefore, "*washoensis*" is placed in the synonymy of *mollis*. Specimens from Pyramid Lake, Wadsworth, Stillwater, and Smoke Creek are typical of *mollis*.

*Specimens examined*.—Total number, 249, as follows:

**California**: Amedee, 1;<sup>8</sup> Honey Lake, 3;<sup>8</sup> Horse Lake (Lassen County), 1; Karlo (Lassen County), 1;<sup>8</sup> Long Valley (Mono County), 2; Mono Lake, 2;<sup>8</sup> Owens Valley, 6; Wendel (Lassen County), 2.<sup>8</sup>  
**Idaho**: American Falls, 6; Gooding, 1;<sup>8</sup> Murphy, 7; Oakley, 1; Payette, 1; Pocatello 10; Rogerson, 1; Rupert, 1;<sup>8</sup> Weiser, 7.  
**Nevada**: Baker (White Pine County), 3;<sup>8</sup> Blair Junction (Esmeralda County), 1;<sup>8</sup> Carlin, 1;<sup>9</sup> Carson, 13; Cave Spring (Esmeralda County), 1;<sup>8</sup> Chiatovich Ranch (Esmeralda County), 1;<sup>8</sup> Cloverdale (Nye County), 1; Elko, 3; Fish Lake Valley (Esmeralda County), 3;<sup>8</sup> Goldfield, 1;<sup>8</sup> Goshute Mountains, 1; Granite Creek (Washoe County), 1; Halleck, 6; Indian Creek (near head, Nye County), 2; Indian Spring (north slope Charleston Mountains), 1;<sup>10</sup> Little High Rock Canyon (Washoe County), 1;<sup>8</sup> Metropolis, 2; Millett (Nye County), 1;<sup>8</sup> Monitor Valley (50 miles north of Belmont), 1; Mount Magruder (=Sugarloaf Peak, Esmeralda County), 15; Nixon (Washoe

<sup>8</sup> Mus. Vert. Zool.

<sup>9</sup> Univ. Michigan Mus. Zool.

<sup>10</sup> D. R. Dickey coll.

- County), 1; Osceola (White Pine County), 1;<sup>8</sup> Palmetto (Esmeralda County), 5;<sup>10</sup> Panaca (Lincoln County), 1;<sup>8</sup> Paradise, 1; Peavine Creek (Nye County), 4; Pine Forest Mountains (Big Creek Ranch), 4;<sup>5</sup> Pyramid Lake, 20; Queen (Mineral County), 6; Quinn River Crossing (Humboldt County), 17;<sup>8</sup> Reese River (Nye County), 4; Round Mountain (Nye County), 3; Steptoe Valley (9 miles south of Schellbourne), 1;<sup>8</sup> Silver Peak Mountains, 1; Smoke Creek (Washoe County), 6; Springdale (Nye County), 4;<sup>10</sup> Stillwater (Churchill County), 1; Summit (Esmeralda County), 1;<sup>10</sup> Toyabe Range, 2; Virginia Mountains (Washoe County), 1; Wadsworth, 3; White River Valley (15 miles southwest of Sunnyside), 1;<sup>8</sup> Whiterock Valley (30 miles southwest of Austin), 1; Winnemucca, 1; Winnemucca Lake, 1.
- Oregon: Disaster Peak (Malheur County), 1; Rome (Malheur County), 2; White Horse Sink (Harney County), about 16 miles east of Alvord Lake, 2.
- Utah: Cedar City, 9;<sup>11</sup> 12 Fairfield, 16; Kelton (Box Elder County), 1;<sup>8</sup> Malone (Millard County), 1; Manti, 1; Midvale, 1; Modena (Iron County), 4; Nephi, 1; Promontory (Box Elder County), 4; Salt Lake City, 3.

## CITELLUS TOWNSENDII ARTEMESIAE MERRIAM

## LEAST IDAHO GROUND SQUIRREL

*Spermophilus townsendi* Merriam, North Amer. Fauna 5: 36, 1891 (not of Bachman).

*Citellus mollis artemesiae* Merriam, Biol. Soc. Wash. Proc. 26: 137, May 21, 1913.

*Citellus mollis* [sic] *pessimus* Merriam, Biol. Soc. Wash. Proc. 26: 138, 1913 (Big Lost River, Idaho).

*Type*.—Collected on Birch Creek, about 10 miles south of Nicholia, Idaho, August 9, 1890, by Vernon Bailey; male adult, skin and skull, no.  $\frac{23489}{30907}$ , U. S. Natl. Mus. (Biological Survey collection) (orig. no. 1573).

*Range*.—Southeastern Idaho, from southern Lemhi County south to the Snake River valley (fig. 1). *Zonal range*: Upper Sonoran.

*External characters*.—Smallest of the races of *C. townsendii*; color slightly darker and more dappled than in *C. t. mollis*, tinged with brownish, and with less buff on sides of head and body.

*Cranial characters*.—Skull decidedly smaller than that of *mollis*, with relatively shorter rostrum.

*Color*.—*Summer pelage* (August): Upper parts pale smoke gray, sometimes faintly washed with pinkish cinnamon; nose and front of face cinnamon; sides of neck and body only faintly tinged with pinkish buff; front feet grayish white, washed with pinkish buff; hind feet grayish white; thighs cinnamon buff; tail above, cinnamon buff mixed with fuscous and with a subterminal patch of fuscous black, tipped with grayish white; tail beneath, dull clay color or cinnamon; under parts creamy white, faintly washed with pinkish buff.

*Measurements*.—Average of 7 adults from type locality: Total length, 179 (167–188); tail vertebrae, 36.6 (32–43); hind foot, 29.7 (29–31). *Skull*: Average of 7 adults from type locality: Greatest length, 33.5 (32.4–35.3); palatilar length, 16 (15.3–16.8); zygomatic breadth, 21.5 (21–23); cranial breadth, 16.3 (15.6–17.1); interorbital breadth, 6.7 (6.4–7); postorbital constriction, 9.8 (9.2–10.3); length of nasals, 12 (11.4–12.7); maxillary tooth row, 7.4.

*Remarks*.—This small race of *townsendii* occupies a rather limited area in southeastern Idaho. The series from Big Lost River, which forms the basis of Merriam's "*pessimus*", is intermediate in size between

<sup>8</sup> Mus. Vert. Zool.

<sup>10</sup> D. R. Dickey coll.

<sup>11</sup> E. R. Warren coll.

<sup>12</sup> Cleveland Mus. Nat. Hist.

*mollis* and *artemesiae* but nearer to the latter. The specimens appear slightly darker than typical *artemesiae* but this may be due to wear, and in any case the difference is too slight to warrant recognition of the form by name.

*Specimens examined*.—Total number, 31, as follows:

Idaho: Berenice (Butte County), 2;<sup>13</sup> Big Lost River, 10; Birch Creek, 7; Blackfoot, 7; Pingree (Bingham County), 2;<sup>13</sup> Taber (Bingham County), 2;<sup>13</sup> Twin Lakes, Snake River Desert (20 miles north of Minidoka), 1.

#### CITELLUS TOWNSENDII VIGILIS MERRIAM

##### MALHEUR VALLEY GROUND SQUIRREL

*Citellus canus vigilis* Merriam, Biol. Soc. Wash. Proc. 26: 137, May 21, 1913.

*Citellus mollis vigilis* Miller, U. S. Natl. Mus. Bull. 128: 188, 1924.

*Type*.—Collected at Vale, Oreg. April 29, 1910, by Stanley G. Jewett; female adult, skin and skull, no. 168361, U. S. Natl. Mus., (Biological Survey collection) (orig. no. 30).

*Range*.—Confined apparently to the lower part of Malheur Valley, Oreg., in the vicinity of Vale and Ontario and north in the Snake River valley to Huntington. *Zonal range*: Upper Sonoran.

*External characters*.—Largest of the races of *C. townsendii*; closely similar in coloration to *C. t. canus*, but averaging slightly more buffy; darker (more buffy) than *C. t. mollis*.

*Cranial characters*.—Skull similar to that of *canus*, but larger; averaging about the same length as that of *mollis*, but zygomatic heavier and more widely spreading; rostrum relatively shorter and broader; maxillary tooth row slightly shorter.

*Color*.—Worn winter pelage (April and May): Upper parts smoke gray, sometimes faintly washed with pinkish cinnamon; front of face with a rather extensive patch of cinnamon; sides of neck and body faintly (rarely strongly) washed with pinkish buff or pale pinkish buff; front feet pinkish buff, hind feet creamy white; tail above and below, cinnamon drab, mixed with fuscous, edged with white or buffy white, and with a subterminal patch of fuscous; under parts creamy white, faintly washed with pinkish buff, the hairs fuscous at base, and this color often more or less prominent in mixture with the lighter tips. *Summer pelage*: Not represented.

*Measurements*.—Average of 10 adults from Ontario and Vale, Oreg.: Total length, 226.2 (201–238); tail vertebrae, 44.4 (35–52); hind foot, 33.1 (31–35). *Skull*: Average of 13 adults from same localities: Greatest length, 38.3 (37.3–39.6); palatilar length, 18.4 (17.5–19.5); zygomatic breadth, 25.5 (24.5–26.7); cranial breadth, 17.8 (17.2–18.4); interorbital breadth, 7.9 (7.3–8.4); postorbital constriction, 9.6 (8.9–10.5); length of nasals, 13.4 (12.8–13.8); maxillary tooth row, 7.7 (7.2–8.2).

*Remarks*.—Living in a rich, fertile valley this race has developed markedly in size and robustness of skull. Its range apparently is quite limited, since the specimens a few miles to the westward of Vale are referable to *canus* and those on the east side of Snake River to *mollis*.

*Specimens examined*.—Total number, 53, as follows:

Oregon: Huntington, 4; Ontario, 23; Vale, 26.

<sup>13</sup> Mus. Vert. Zool.

## CITELLUS TOWNSENDII CANUS (MERRIAM)

## GRAY GROUND SQUIRREL

*Spermophilus mollis canus* Merriam, Biol. Soc. Wash. Proc. 12: 70, Mar. 24, 1898. [*Citellus mollis*] *canus* Trouessart, Cat. Mamm., Sup., p. 339, 1904.

*Type*.—Collected at Antelope, Wasco County, Oreg., June 21, 1896, by Vernón Bailey; female adult, skin and skull; no. 78681, U. S. Natl. Mus. (Biological Survey collection) (orig. no. 5561).

*Range*.—Eastern Oregon and extreme northwestern Nevada; north to Antelope; west to Warmspring, Bend, and Summer Lake; south to Summit Lake, Nev.; east to Catlow Valley and Cedar Mountains, Oreg. (fig. 1). *Zonal range*: Upper Sonoran.

*External characters*.—Closely similar in color to *C. t. mollis*; tail and hind feet shorter. Similar also to *C. t. vigilis* but smaller; cinnamon patch on face paler.

*Cranial characters*.—Skull similar in shape to that of *vigilis* but smaller. Compared with *mollis*: Shorter and relatively broader, the zygomatica more wide spreading; bullae averaging smaller; rostrum relatively short and broad.

*Color*.—*Summer pelage* (June 20–July 14): Upper parts smoke gray, often with a faint wash of pinkish cinnamon and frequently more or less darkened by exposure of the subterminal fuscous areas of the hairs; patch on front of face pinkish cinnamon; sides of face, neck, and body sometimes faintly shaded with pinkish buff; tail and feet as in *vigilis*. *Worn winter pelage*: Practically as in summer. *Immature pelage*: Similar to the adult pelage but often strongly shaded on sides of head and body with pinkish buff or cinnamon buff.

*Measurements*.—Average of 10 adults from Antelope, Gateway, and Prineville, Oreg.: Total length, 201.4 (190–217); tail vertebrae, 39.4 (37–42); hind foot, 30.7 (29–33). *Skull*: Average of 10 adults from Antelope and Gateway: Greatest length, 36.3 (34.6–38); palatilar length, 17.3 (16.5–18.5); zygomatic breadth, 23.9 (23.1–24.5); cranial breadth, 17.6 (17–18.2); interorbital breadth, 7.5 (7–8); postorbital constriction, 10.1 (9.3–11); length of nasals, 12.9 (12.2–13.6); maxillary tooth row, 7.4 (7–7.8).

*Remarks*.—This small gray race occupies most of the desert valleys of eastern Oregon except the extreme southeastern part, intergrading with the larger *vigilis* in the extreme eastern part of the State and with *mollis* in southern Malheur County and in northwestern Nevada. There are no records of its occurrence in northern Oregon, north of Antelope.

*Specimens examined*.—Total number, 97, as follows:

**Nevada**: Hot Springs, Thousand Creek, 3;<sup>14</sup> Summit Lake (Humboldt County), 1; Virgin Valley (Humboldt County), 3.<sup>14</sup>  
**Oregon**: Antelope (7 miles east), 7; Baker (10 miles north), 3;<sup>15</sup> Barnes (Cook County), 1;<sup>14</sup> Bend, 11; Burns, 2; Cedar Mountains (Malheur County), 1; Christmas Lake (10 miles north), 1; Crane (Harney County), 6; Drewsey, 2; Fremont, 1; Gateway (Jefferson County), 15; Haycreek (Jefferson County), 5; Malheur Lake, 1; Narrows, 17; Plush (Lake County), 1; Prineville, 6; Riverside (Malheur County), 1; Rock Creek (Harney County), 4; Summer Lake, 2; Warmspring (Jefferson County), 3.

<sup>14</sup> Mus. Vert. Zool.

<sup>15</sup> Univ. Michigan Mus. Zool.

## CITELLUS IDAHOENSIS MERRIAM

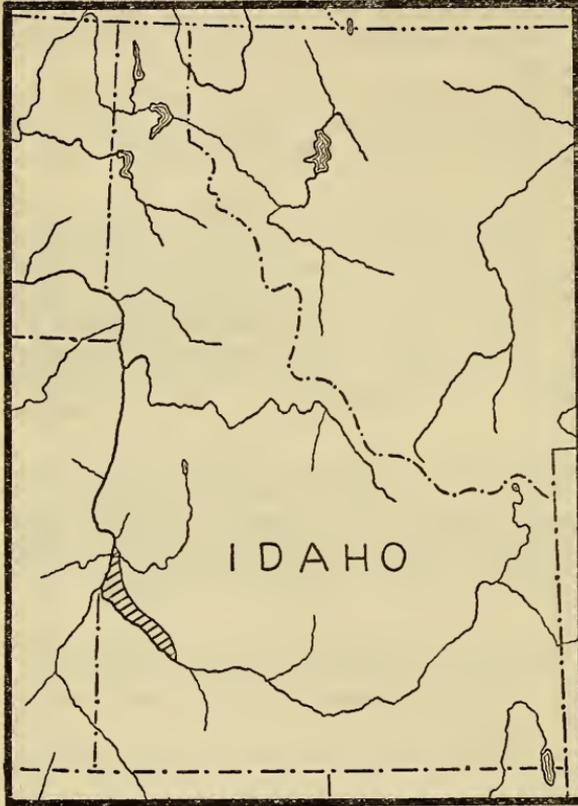
## SNAKE VALLEY GROUND SQUIRREL

(PLS. 23, B; 28, B)

*Citellus idahoensis* Merriam, Biol. Soc. Wash. Proc. 26: 135, May 21, 1913.

*Type*.—Collected at Payette, Idaho, April 23, 1910, by Stanley G. Jewett; female adult, skin and skull, no. 168290, U. S. Natl. Mus. (Biological Survey collection) (orig. no. 17).

*Range*.—North side of Snake River Valley, Idaho, from Payette to Glenns Ferry (fig. 2). *Zonal range*: Upper Sonoran.

FIGURE 2.—Distribution of *Citellus idahoensis*.

*External characters*.—Similar to *C. townsendii mollis* but larger; tail longer, and more tawny; upper parts slightly darker and more distinctly dappled. Compared with *C. richardsonii elegans*: Size smaller; tail shorter and darker; coloration more grayish (less brownish or buffy).

*Cranial characters*.—Skull similar to that of *C. townsendii vigilis*, but averaging larger; nasals and molariform tooth row longer; similar also to that of *mollis* but decidedly larger; auditory meatus longer.

*Color*.—*Unworn winter pelage* (April): Upper parts pale smoke gray, faintly or moderately shaded with pinkish buff or cinnamon buff, with a slight indication of

mottling; a basal zone of deep mouse gray on the back, succeeded by a zone of smoke gray and then by a subterminal band of fuscous. Patch on front of face sayal brown; sides of body faintly washed with pinkish buff; front feet pinkish buff; hind feet buffy whitish; tail above, mixed pinkish cinnamon and fuscous edged with buffy white and with a subterminal band of fuscous; tail beneath, cinnamon or sayal brown; under parts grayish white, faintly washed with pinkish buff, the bases of the hairs fuscous. *Worn winter pelage* (June 4): General tone of upper parts pale snuff brown sprinkled with pinkish buff (the brownish tones due largely to exposure of the subterminal bands on the hairs).

*Measurements.*—Average of 20 adults from Payette and Nampa, Idaho: Total length, 245.9 (222–271); tail vertebrae, 59.2 (46–72); hind foot, 35.6 (33–38). *Skull:* Average of 16 adults from same localities: Greatest length, 40.1 (37.7–43.3); palatilar length, 19.4 (18–21.2); zygomatic breadth, 25.9 (25–26.8); cranial breadth, 18 (17–19); interorbital breadth, 8.2 (7.3–8.8); postorbital constriction, 9.7 (9–10.5); length of nasals, 14.3 (13.6–15.2); maxillary tooth row, 8.3 (7.8–9).

*Remarks.*—*C. idahoensis*, although evidently belonging in the *townsendii* group, is clearly a distinct species, since it occurs in certain areas with *C. t. mollis* and maintains its characters without intergradation. It is best distinguished from *C. t. mollis* or *C. t. vigilis* by its longer, broader, and more tawny tail, and by the more pronounced mottled effect on the upper parts. The skulls show extreme variation in size, and the smallest ones are scarcely distinguishable from those of *vigilis*, though usually having a longer and heavier molar tooth row. So far as known, the species occupies a rather restricted range on the north side of the Snake River Valley in western Idaho.

*Specimens examined.*—Total number, 118, as follows:

Idaho: Glens Ferry, 3; Kuna (Ada County), 7; Mountain Home, 9; Nampa, 67; Orchard (Ada County), 6; Payette, 26.

#### CITELLUS WASHINGTONI GROUP

#### CITELLUS WASHINGTONI, SP. NOV.

[Synonymy under subspecies.]

*General characters.*—About the size of *C. townsendii mollis*; hind foot, 30–38 mm; tail, 32–65; skull length, 35–41.4. Skull similar to that of *C. t. townsendii* but relatively longer and narrower; smaller and relatively narrower than those of *C. idahoensis* and *C. brunneus*. Upper parts smoke gray, flecked with whitish spots; tail mixed fuscous and grayish white, with blackish tip.

#### CITELLUS WASHINGTONI WASHINGTONI, SUBSP. NOV.

#### WASHINGTON GROUND SQUIRREL

(Pls. 1; 23, C; 28, C)

*Citellus townsendii* Dice, Jour. Mammal. 1: 18, 1919; Bailey, North Amer. Fauna 55: 151, 1936 (not *Spermophilus townsendii* Bachman).

*Type.*—Collected at Touchet, Walla Walla County, Wash., May 18, 1891, by Clark P. Streater; male adult, skin and skull; no.  $\frac{27948}{40058}$ , U. S. Natl. Mus. (Biological Survey collection) (orig. no. 817).

*Range.*—Southeastern Washington and northern Oregon; north to southern Adams County, Wash.; east at least to the Idaho-Washington boundary; south to Heppner, Oreg.; west to Willows, Oreg. (fig. 3). *Zonal range:* Upper Sonoran.

*External characters.*—Size medium; tail short; dorsal area distinctly spotted, general tone grayish.

*Cranial characters.*—Skull similar to that of *C. idahoensis* but averaging smaller, and relatively narrower; interorbital constriction narrower; postorbital processes narrower at base and very slender throughout; ascending arms of premaxillae narrower than the nasals (about equal in *idahoensis*); auditory meatus much shorter. Com-

pared with *C. townsendii townsendii*: Skull averaging larger, with relatively narrower brain case and interorbital region.

*Color*.—*Winter pelage* (March): General tone of upper parts pale smoke gray, faintly washed (except on head) with pinkish buff, the entire back flecked with squarish, grayish white spots averaging about 3 or 4 mm in breadth; patch on nose and front of face cinnamon; eyes surrounded with a narrow whitish ring; sides of body very faintly washed with pale buff; feet whitish, tinged with pinkish buff, thighs pinkish cinnamon; tail above, grayish mixed with fuscous, with a subterminal band of fuscous black, tipped with buffy white; tail beneath, pinkish cinnamon sometimes mixed with fuscous and edged with buffy white; under parts grayish white, washed with pinkish buff, the bases of the hairs fuscous. *Summer pelage* (August): Upper parts more brownish or fuscous than in

winter, due apparently to wearing away of the whitish or buffy tips on the hairs and exposure of the subterminal brownish areas.

*Molt*.—Numerous specimens taken in May and June are in badly worn pelage, but no clear indications of the molt have been found in the series examined; probably, as in the case of other species, the pelage is renewed during the early part of summer.

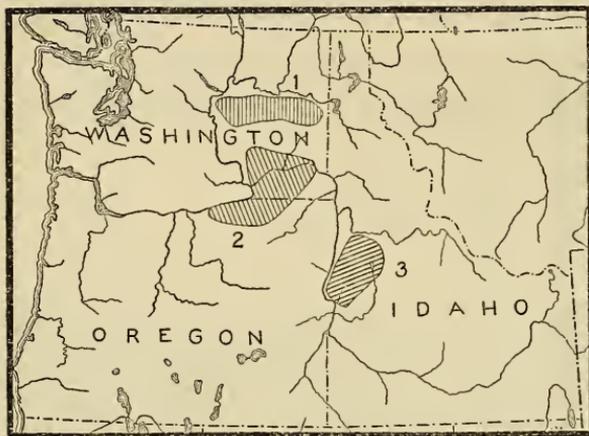


FIGURE 3.—Distribution of *Citellus brunneus* and subspecies of *C. washingtoni*: 1, *C. w. loringi*; 2, *C. w. washingtoni*; 3, *C. brunneus*.

*Measurements*.—Average of 15 adults from Wallula, Pasco, and Touchet, Wash.: Total length, 229.2 (212–245); tail vertebrae, 50 (40–65); hind foot, 35.3 (34–38). *Skull*: Average of 16 adults (5 males, 11 females) from same localities: Greatest length, 38.5 (36.8–41.4); palatilar length, 18.3 (17–20); zygomatic breadth, 24.8 (23.3–26.2); cranial breadth 17.2 (16.3–18.3); interorbital breadth, 7.4 (6.6–8.2); postorbital constriction, 9.2 (8–10.3); length of nasals, 13.8 (13–15.6); maxillary tooth row, 7.8 (7.3–8.3). Oregon specimens average larger than those from the type region; average of 10 adult males from Pendleton and Willows: Greatest length, 39.4 (38.5–41.8); zygomatic breadth, 26 (24.8–27.5); cranial breadth, 18.1 (16.8–18.7).

*Weight*.—Shaw (1925, p. 764) gives the weight of a male at time of entering hibernation as 280 g; on awakening at the end of a period of 56 days the same animal weighed 221 g.

*Remarks*.—This ground squirrel has been known for nearly half a century under the name *Citellus townsendii*, but as shown on page 62, that name is applicable to another species. Therefore it has become necessary to provide a name for the species under consideration.

The Washington ground squirrel is easily recognized among the American forms by its relatively short tail and conspicuous dorsal spotting. It is spotted much as in certain forms of *C. spilosoma*, but the latter have longer tails, harsher pelage, and differ widely in

skull characters. The present form resembles *C. guttatus* of southern Russia rather closely in general appearance, but the available material does not permit of detailed comparison. There is, of course, no chance of close relationship between the two.

The nearest relative of *C. washingtoni* is *C. brunneus* of west-central Idaho, originally described by the writer as a subspecies of *townsendii* [= *washingtoni*], but now believed to be a distinct species.

The range of this species is separated from that of *C. townsendii townsendii* by the Columbia River; in northern Oregon, *washingtoni* occupies an area west of the Blue Mountains and east of John Day River, while *C. townsendii canus* occupies most of the semidesert regions of the State to the southward. The ranges of *washingtoni* and *townsendii* apparently do not overlap.

*Specimens examined*.—Total number, 112, as follows:

Oregon: Cold Springs (Umatilla County), 1; Heppner, 9; Pendleton, 17; Pilot Rock (Umatilla County), 3; Umatilla, 1; Vinson (Umatilla County), 2; Willows (Gilliam County), 6; Willows Junction, 1.

Washington: Almota (Whitman County), 4; Columbia River, 1;<sup>16</sup> Riparia (Whitman County), 1; Othello (Adams County), 1;<sup>17</sup> Pasco, 19; Pataha (Columbia County), 8;<sup>17</sup> Touchet, 27; Wallula, 8;<sup>18</sup> Wawawai, 2.<sup>19</sup>

#### CITELLUS WASHINGTONI LORINGI, SUBSP. NOV.

##### LORING'S GROUND SQUIRREL

*Type*.—Collected at Douglas, Wash., August 1, 1897, by J. Alden Loring; male adult, skin and skull; no. 89805, U. S. Natl. Mus. (Biological Survey collection) (orig. no. 4547).

*Range*.—Plains of east-central Washington, south and east of the Columbia River, including most of Douglas, Grant, Lincoln, and Adams Counties; east to Spokane County (fig. 3). *Zonal range*: Upper Sonoran.

*Characters*.—Similar in color and cranial characters to *C. w. washingtoni* but smaller.

*Measurements*.—Average of 10 adult males from type region (Douglas, Waterville, Baird, Farmer, Coulee City): Total length, 203 (185–224); tail vertebrae, 39.6 (32–48); hind foot, 30.8 (30–33). Skull: Average of 10 adult males from same localities: Greatest length, 36.4 (35–38); palatilar length, 17.5 (17–18); zygomatic breadth, 23.4 (22.6–24.5); cranial breadth, 17.2 (16.4–18); interorbital breadth, 7 (6.4–7.7); postorbital constriction, 9.7 (9–11); length of nasals, 13.4 (12.3–14.7); maxillary tooth row, 7.7 (7.5–8).

*Remarks*.—This race, occupying the high plains at the northern limit of the range of the species, is characterized mainly by being smaller than the typical form. Specimens from Sprague, Wash., are intermediate between *loringi* and the typical race.

*Specimens examined*.—Total number, 20, as follows:

Washington: Baird (Douglas County), 3; Cheney, 1; Coulee (Grant County), 2; Douglas, 2; Farmer (Douglas County), 2; Harrington, 1; Mansfield, 1; Moses Coulee (Douglas County), 1; Sprague, 5; Waterville, 1; Wilbur, 1.

<sup>16</sup> Type, Acad. Nat. Sci. Philadelphia.

<sup>17</sup> Univ. Michigan Mus. Zool.

<sup>18</sup> Four in Univ. Michigan Mus. Zool.

<sup>19</sup> Field Mus. Nat. Hist.

## CITELLUS BRUNNEUS HOWELL

## IDAHO SPOTTED GROUND SQUIRREL

(Pls. 23, D; 28, D)

*Citellus townsendii brunneus* Howell, Biol. Soc. Wash. Proc. 41: 211, Dec 18, 1928.

*Type*.—Collected at New Meadows, Adams County, Idaho, July 11, 1913, by L. E. Wyman; female adult, skin and skull, no. 201963, U. S. Natl. Mus. (Biological Survey collection) (orig. no. 178).

*Range*.—West central Idaho, in Washington, Adams, and Valley Counties; limits of range unknown (fig. 3). *Zonal range*: Transition and Upper Sonoran.

*External characters*.—Similar to *C. washingtoni washingtoni* but color of upper parts more brownish (less grayish) and the dorsal spots smaller; cinnamon patch on face darker and more extensive; tail longer and darker (more blackish); ears much larger, raised conspicuously above the crown. Compared with *C. idahoensis*: Upper parts more brownish and distinctly spotted; tail with more black; ears larger.

*Cranial characters*.—Skull similar to that of *washingtoni* but averaging larger and relatively broader, especially the rostrum and the postorbital region; nasals longer; last upper molar with posterior loph practically obsolete. Compared with *idahoensis*: Skull averaging slightly smaller but broader across postorbital region; nasals larger (both longer and broader); audital bullae smaller; external meatus shorter.

*Color*.—*Summer pelage* (July): General tone of upper parts smoke gray, more or less heavily washed on the back with pinkish cinnamon or sayal brown, and moderately sprinkled with small, quadrangular spots of grayish white; front of face with a rather extensive patch of sayal brown; eyes surrounded with a broad ring of creamy white; sides of neck and body faintly washed with pinkish buff; feet pinkish buff; thighs pale russet; tail above, dark sayal brown at base, shaded on distal portion with fuscous black and all sprinkled with grayish white; tail beneath, cinnamon, shaded with grayish white and fuscous, and edged with cinnamon buff; under parts grayish white, shaded with pinkish buff.

*Measurements*.—Average of 13 adults from type region (New Meadows, Midvale, Van Wyck, Goodrich, and Weiser): Total length, 232.5 (214–252); tail vertebrae, 56.7 (51–61); hind foot, 34.2 (33–37); ear from notch, 10.5 (9–12). *Skull*: Average of 5 adult males from Weiser and Midvale, Idaho: Greatest length, 40.1 (38.7–40.8); zygomatic breadth, 25.5 (24.9–26.1); palatilar length, 18.6 (18–19); cranial breadth, 18.4 (18.1–18.5); interorbital breadth, 8.3 (7.5–9.2); postorbital constriction, 10.9 (10.4–11.6); length of nasals, 14.8 (13.7–16.1); maxillary tooth row, 8.4 (8.1–8.8). Average of 3 adult females (including type): Greatest length, 37.3 (36.4–38.2); palatilar length, 17.3 (17–18); zygomatic breadth, 23.8 (23.4–24.1); cranial breadth, 17.8 (17.2–18.6); interorbital breadth, 7.8 (7.6–8.1); postorbital constriction, 10.4 (9.5–11.2); length of nasals, 13.4 (13.1–13.8); maxillary tooth row, 7.9 (7.5–8.2).

*Remarks*.—This well-marked species apparently has a rather restricted distribution in west-central Idaho, where it meets or slightly overlaps the range of *C. townsendii mollis* (at Weiser). It is readily distinguished from both *idahoensis* and *mollis* by its distinct dorsal spotting and its large ears.

Originally described by the writer as a subspecies of *C. townsendii* [= *washingtoni*], it appears on more detailed comparison to be a distinct species, distinguished from *washingtoni* by larger ears, longer and darker tail, smaller dorsal spots, and by the skull characters pointed out above.

*Specimens examined*.—Total number, 14, as follows:

**Idaho:** Goodrich (Adams County), 1; Midvale (Washington County), 3; New Meadows (Adams County), 2; Van Wyck (Valley County), 2; Weiser, 6.

CITELLUS RICHARDSONII GROUP

CITELLUS RICHARDSONII (SABINE)

[Synonymy under subspecies]

*Specific characters*.—Size medium to large; hind foot 39.5–48 mm; tail 65–100; skull length 42–48.6. Dorsal outline of skull convex, the highest point being between the postorbital processes; brain case narrow and deep, much constricted anteriorly; postorbital processes long, slender, and decurved; interorbital constriction pronounced; zygomata heavy and broad, widely expanded posteriorly, narrowing anteriorly; rostrum moderately narrow; nasals ending nearly on the plane of the posterior ends of premaxillae, or shorter; antorbital canal suborbicular; upper tooth rows slightly convergent posteriorly; auditory bullae rather small, low and broad; auditory meatus slightly produced; upper incisors moderately slender and nearly straight.

Coloration of upper parts drab or smoke gray, more or less shaded with fuscous and dappled with cinnamon buff; under parts pale buff or cinnamon buff; under side of tail clay color, cinnamon buff, or sayal brown.

CITELLUS RICHARDSONII RICHARDSONII (SABINE)

RICHARDSON'S GROUND SQUIRREL

(Pls. 2; 25, *F*; 30, *F*)

*Arctomys richardsonii* Sabine, Trans. Linn. Soc. London 13: 589, 1822.

*Arctomys (Spermophilus) richardsonii* Richardson, Fauna Boreali-Amer., p. 164, 1829.

*Spermophilus richardsonii* F. Cuvier, Sup. à l'hist. natur. Buffon 1: 323, 1831.

[*Citellus*] *richardsoni* Trouessart, Cat. Mamm., Sup., p. 338, 1904.

*Type* (lectotype).<sup>21</sup>—Collected at Carlton House, Saskatchewan, by Sir John Richardson; no. 63a, British Museum.

*Range*.—Plains of southern Alberta, southern Saskatchewan, southwestern Manitoba, northern and central Montana, North Dakota (except southwestern part), and northeastern South Dakota; north to the North Saskatchewan River; east to the Red River Valley, N. Dak., Big Stone Lake, S. Dak., and the western edge of Minnesota; south to east-central South Dakota (Jerauld County), and southwestern Montana (Gallatin and Park Counties); west to the foothills of the Rocky Mountains in Alberta and Montana (fig. 4).

*Zonal range*: Transition.

*External characters*.—Size large; hind foot, 43–47 mm; tail about one-fourth the total length; ears broad and low (2–4 mm above

<sup>21</sup> Selected by O. Thomas (1927, p. 545).

crown); coloration above nearly uniform buffy or drab, with slight "dappling"; under parts deep buff in summer pelage.

*Cranial characters.*—As given under specific characters; compared with *C. r. elegans*, the skull is larger, with longer and relatively narrower rostrum.

*Color.*—*Fresh summer pelage* (July): General tone of upper parts pinkish buff or cinnamon buff, shaded with fuscous (caused by exposure of the subterminal bases of the hairs), the posterior part of back showing a distinctly "dappled" effect; nose with a large patch of cinnamon; eye ring light buff; sides of head and neck and front of fore legs cinnamon buff or clay color; sides of body and under parts pinkish buff or cinnamon buff; hind feet pinkish buff; tail above, fuscous black, mixed with pinkish buff and broadly edged with the same; tail beneath, cinnamon buff or clay color, edged with pinkish buff. In worn pelage much of the buffy tone of the upper parts is lacking, the general effect being near smoke gray.

*Molt.*—Apparently the molt may occur at any time in the spring or summer. Specimens taken in April at Choteau, Mont., are in a

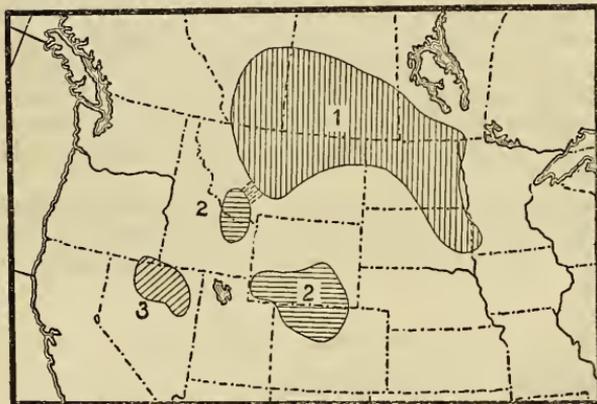


FIGURE 4.—Distribution of the subspecies of *Citellus richardsonii*: 1, *C. r. richardsonii*; 2, *C. r. elegans*; 3, *C. r. nevadensis*.

much-worn pelage and one—a breeding female—shows a patch of new hair extending along the middle of the back from the head nearly to the rump. Another adult female from Blackfoot, Mont., June 12, is in similar condition of molt. An adult female from Wingard, Saskatchewan, July 15, is much worn on the anterior half of the body and shows

new pelage covering the posterior half to the middle of the back.

*Measurements.*—Average of 16 adults (7 males, 9 females) from type locality: Total length, 285.4 (277–306); tail vertebrae, 73.8 (65–83); hind foot, 44.9 (43–47). *Skull:* Average of 7 adult males from type locality: Greatest length, 47.7 (47.3–48); palatilar length, 23.7 (23–25); zygomatic breadth, 31.9 (30.5–33.5); cranial breadth, 20.2 (19.9–20.8); interorbital breadth, 9.9 (9.5–10.6); postorbital constriction, 11.4 (10.8–11.9); length of nasals, 17.4 (17–18); maxillary tooth row, 10.4 (10.2–10.7). Average of 8 adult females from type locality: Greatest length, 46.5 (45.1–48.4); palatilar length, 23.1 (22.5–24); zygomatic breadth, 30.4 (29.5–31.2); cranial breadth, 19.6 (19–20.9); interorbital breadth, 9.5 (8.8–10); postorbital constriction, 11.1 (10.8–11.5); length of nasals, 16.9 (16–18.1); maxillary tooth row, 10.4 (10–10.9). Average of 6 adults (3 males, 3 females) from Choteau County, Mont.: Greatest length, 48.1 (46.5–49.9); palatilar length, 24.4 (23.2–26); zygomatic breadth, 32.5 (31.5–33.1); cranial breadth, 20 (19.2–20.8); interorbital breadth, 9.8 (8.7–11.7); postorbital constriction, 10.6 (9.8–11.2); length of nasals, 17.8 (17.2–18.7); maxillary tooth row, 10.5 (10.1–11).

*Weight.*—In spring, 11 to 13 ounces; in fall 16 to 17½ ounces (Bailey, 1926, p. 58).

*Remarks.*—Richardson's ground squirrel has an extensive range in the Great Plains region of southern Canada, Montana, and the Da-

kotas. The species apparently has extended its range southward in South Dakota in recent years and is now found regularly along the northern border of Jerauld, Sanborn, Miner, and Lake Counties, with several outlying records of occurrence in Hanson County in 1932.

It is reported also to have extended its range into western Minnesota; Surber (1932, p. 58) states that colonies have recently been established in Norman County and near Enok, Kittson County; Louis Knowles reports that these ground squirrels invaded the western borders of the counties of Traverse, Big Stone, and Lac qui Parle in 1934.

In Gallatin County, Mont., *richardsonii* grades into the smaller and darker race, *elegans*, which occupies most of the southwestern corner of the State.

*Specimens examined*.—Total number, 349, as follows:

**Alberta:** Calgary, 8;<sup>22</sup> Red Deer, 7.

**Manitoba:** Brandon (18 miles east), 1;<sup>23</sup> Carberry, 56; Petrel (Norfolk District), 1.

**Montana:** Blackfoot (Glacier County), 11; Blackfoot Agency (Glacier County), 6; Big Belt Mountains (Meagher County, south of Fort Logan), 3; Big Timber Creek, Crazy Mountains (Sweetgrass County), 4; Birch Creek (Teton County), 4; Bozeman, 10; Bruno (Meagher County), 3;<sup>24</sup> Buffalo (Fergus County), 1; Chief Mountain (Glacier County), 1; Choteau, 11; Dry Creek (Gallatin County), 2; East Gallatin River, 4; Flat Willow Creek, 3;<sup>24</sup> Fort Ellis (near Bozeman), 1; Frenchmans River (at international boundary), 4; Glasgow, 5; Great Falls, 1; Grafton (Judith Basin County), 1; Johnson Lake (Roosevelt County), 2; Lewistown, 3; Livingston, 5; Manhattan (Gallatin County), 2; Martinsdale (10 miles east, Wheatland County), 2; Milk River (at mouth, at 49°, and at Two Forks), 5; Moccasin Mountains (Fergus County), 3; Philbrook (Judith Basin County), 1; Ringling (10 miles south, Meagher County), 3;<sup>24</sup> Roy (Fergus County), 1; St. Mary, Glacier National Park, 11;<sup>25</sup> Sedan (Gallatin County), 2;<sup>24</sup> Shelby Junction, 5; Summit (near Ringling, Meagher County), 1; Sun River Crossing (Cascade County), 1; Teton (Choteau County), 1; Three Buttes (on International boundary, Hill County), 15; Toston (Broadwater County), 1;<sup>24</sup> Townsend (Broadwater County), 3;<sup>24</sup> Tyler (Fergus County), 1; Ubet (Wheatland County), 5; West Gallatin River (Lower Basin), 1; West Gallatin and Spanish Canyons (Gallatin County), 3.<sup>24</sup>

**North Dakota:** Ashley, 1; Bismarck, 11; Bottineau, 8; Bowdon, 2;<sup>27</sup> Buford (Williams County), 6; Crosby, 1; Devils Lake, 15; Drayton, 6; Ellendale, 1; Grafton, 6; Hankinson, 1; Kenmare, 1; LaMoure, 6; Larimore, 2; Lisbon, 1; Lostwood (Mountrail County), 1; Pembina, 2; Rush Lake (Cavalier County), 2; St. John (Rolette County), 2; Starkweather (Ramsey County), 1; Stump Lake (Nelson County), 1;<sup>26</sup> Towner, 1; Turtle Creek (near Washburn), 1; Turtle Mountains, 2; Washburn, 4.

**Saskatchewan:** Carleton, 5; Indian Head, 3; Livelong, 1;<sup>26</sup> Moosejaw, 3; Wingard, 20.

**South Dakota:** Aberdeen, 2; Frederick, 4; Walworth County, 1.

<sup>22</sup> Five in collection of C. B. Garrett.

<sup>23</sup> Kansas Univ. Mus.

<sup>24</sup> Montana State College.

<sup>25</sup> Univ. Michigan Mus. Zool.

<sup>26</sup> William T. Shaw coll.

<sup>27</sup> Carnegie Mus.

## CITELLUS RICHARDSONII ELEGANS (KENNICOTT)

## WYOMING GROUND SQUIRREL

(Pls. 25, *E*; 30, *E*)*Spermophilus elegans* Kennicott, Acad. Nat. Sci. Phila. Proc. 1863: 158.[*Spermophilus richardsoni*] var. *elegans* Allen, Boston Soc. Nat. Hist. Proc. 16: 292, 1874.[*Spermophilus richardsoni*] var. *townsendi* Allen, Monog. North Amer. Rodentia, p. 850, 859, 1877 (part).[*Citellus elegans* Trouessart, Cat. Mamm., Sup., p. 339, 1904.

*Cotypes*.—Collected at Fort Bridger, Wyo., April and May 1858, by C. Drexler; female, skin and fragments of skull, no.  $\frac{3479}{4810}$ ; male, skin and part of skull inside, no. 3480; skin no. 5955; skin (in alcohol) and skull, no.  $\frac{5959}{814}$ ; alcoholics, nos. 5951, 5952, 5953, 5954; also, a few other fragments in U. S. Natl. Mus. (Lyon and Osgood, 1909, p. 165).

*Range*.—Southwestern Montana, southeastern Idaho, southern Wyoming, and northwestern Colorado; north to Madison and Beaverhead Counties, Mont., and northwestern Converse County, Wyo.; east to extreme southeastern Wyoming; south to Leadville, Colo.; west to Custer County (Big Lost River Valley), Idaho (fig. 4). *Zonal range*: Mainly Transition.

*External characters*.—Similar to *C. r. richardsonii* but smaller, with shorter hind feet; coloration of upper parts in summer less buffy (more grayish or brownish); under parts and sides of head and shoulders paler in summer pelage; tail usually darker and more blackish beneath, but with paler edgings.

*Cranial characters*.—Skull similar to that of *richardsonii* but smaller; rostrum shorter and relatively broader; nasals shorter.

*Color*.—General tone of upper parts light drab, more or less flecked with light pinkish buff, some specimens showing a decided pinkish or brownish tone on the middle of the back, the head and shoulders frequently more or less washed with smoke gray; nose cinnamon buff, clay color, or pinkish cinnamon; eye ring white or buffy white; feet pinkish buff or ivory yellow; tail above, similar on basal portion to the back, the terminal half broadly bordered with fuscous black and edged with pale buff; tail beneath, cinnamon buff or pale cinnamon, bordered on terminal portion with fuscous black; lower sides and under parts cartridge buff.

*Measurements*.—Average of 10 adults from Fort Bridger and New Fork of Green River, Wyo.: Total length, 262.3 (253–272); tail vertebrae, 72.9 (66–78); hind foot, 40.7 (39.5–43). *Skull*: Average of 12 adults (9 males, 12 females) from vicinity of type locality (Fort Bridger, Evanston, Cumberland, Lone Tree): Greatest length, 43.1 (42–44.8); palatilar length, 20.9 (20–22.2); zygomatic breadth, 28.8 (27.5–30); cranial breadth, 19.7 (18.7–20.5); interorbital breadth, 9.3 (8.5–10); postorbital constriction, 11.3 (10.5–11.7); length of nasals, 15.3 (14.7–16.1); maxillary tooth row, 9.4 (9–9.7).

*Remarks*.—The Wyoming ground squirrel was originally described by Kennicott as a distinct species. Allen (1877, p. 850), correctly associated it with *C. richardsonii* as a variety, but misapplied Bachman's name *townsendii* to it. It continued to be known by that name until 1891, when Merriam revived Kennicott's name for it and suggested that it might prove to be a subspecies of *richardsonii*. The material now available shows this to be the case, intergradation between the two forms occurring in Gallatin County, Mont. Specimens of *elegans* in winter pelage are scarcely distinguishable from

comparable specimens of *C. r. richardsonii*, except by their smaller size, but in summer pelage *elegans* is decidedly grayer and less buffy.

*Specimens examined*.—Total number, 229, as follows:

- Colorado:** Canadian Creek (North Park), 3; Coulter (Grand County), 6; Elkhorn (Larimer County, near Log Cabin), 2; Estes Park, 1;<sup>28</sup> Fairplay, 2; Fish Creek (Routt County), 2; Fort Collins (Buckhorn Ranger Station), 6; Garo (Park County), 1; Leadville (10 miles south), 2;<sup>28</sup> Mount Whitely (Grand County), 1; Rabbit Ear Mountains (Jackson County), 1; Sopris National Forest (west of Thomasville), 1; Steamboat Springs (15 miles west), 3; Wolcott (Eagle County), 1.<sup>29</sup>
- Idaho:** Birch Creek (Clark County), 5; Dickey (Custer County), 10; Forney, 1; Henry Lake, 1; Lemhi Mountains (west of Junction), 1; Montview, 1; Patterson (Bingham County), 3; Pleasant Valley (Clark County), 1.
- Montana:** Alder, 1; Big Hole Bench (west of Wisdom, Beaverhead County), 1; Dillon, 14;<sup>30</sup> Ennis Lake, 2; Harrison, 3; Lakeview, 2; Lower Redrock Lake (Beaverhead County), 1;<sup>31</sup> Pony (Madison County), 1; Red Bluff (Madison County), 1; Virginia City, 5; Wisdom (9 miles north, Beaverhead County), 3.<sup>31</sup>
- Wyoming:** Altvan (Laramie County), 1; Bear Creek (Albany County, near Eagle Peak), 1; Big Piney (Sublette County), 1; Big Sandy (Sublette County), 2; Bitter Creek, 5;<sup>32</sup> Bridger Pass (Sweetwater County), 7; Bridger Peak, Sierra Madre Mountains, 1; Cheyenne, 8; Cokeville, 6; Cumberland, 9; Evanston, 4; Fort Bridger (Uinta County), 18; Fort Russell (Laramie County), 6; Fort Saunders (=Laramie), 1; Fort Steele (Carbon County), 2; Fossil (Lincoln County), 8; Green River (City), 3; Green River (at mouth of New Fork), 5; Islay (Laramie County), 2; Kemmerer, 1; Kinney Ranch (Bitter Creek, Sweetwater County), 3; Laramie, 1; Laramie River, 1; Laramie Mountains, 3; Little Medicine Bow River (Carbon County), 1; Little Piney Creek (Sublette County), 1; Lonetree (Uinta County), 9; Medicine Bow Mountains, 2; Mountainview (Uinta County), 2; New Fork, Green River (Lander Road), 4; Opal (Lincoln County), 1; Pinedale, 2; Poison Spider Creek (Natrona County), 1; Pole Mountain (15 miles southeast of Laramie), 2; Rawlins, 2; Riverside (Carbon County), 1; Sage (Lincoln County), 4; South Pass City (Fremont County), 1; Superior, 4; Woods P. O. (Medicine Bow Mountains, Albany County), 4.

#### CITELLUS RICHARDSONI NEVADENSIS HOWELL

##### NEVADA GROUND SQUIRREL

*Citellus elegans nevadensis* Howell, Biol. Soc. Wash. Proc. 41: 211, Dec. 18, 1928.

*Type*.—Collected at Paradise, Humboldt County, Nev., March 3, 1908, by Stanley E. Piper; female adult, skin and skull; no. 156788, U. S. Natl. Mus. (Biological Survey collection) (orig. no. 112).

*Range*.—Northern Nevada, extreme southeastern Oregon, and extreme southwestern Idaho; from Paradise Valley, east to Metropolis and south to Ruby Valley, Nev. (fig. 4). *Zonal range*: Upper Sonoran and Transition.

*External characters*.—Similar to *C. r. elegans* but larger, with longer tail and hind feet; upper parts averaging more grayish (less brownish), especially on head and shoulders; under parts darker buff. Compared with *C. beldingi oregonus*: Size larger; upper parts paler and more buffy (less reddish); under parts more buffy; tail paler and less reddish beneath.

*Cranial characters*.—Skull similar to that of *elegans* but averaging decidedly larger; postorbital constriction averaging less. Compared

<sup>28</sup> Univ. of Michigan Mus. Zool.

<sup>29</sup> State Hist. Soc. of Colorado (Denver).

<sup>30</sup> Eight in Kansas Univ. Mus. Nat. Hist.

<sup>31</sup> Montana State College.

<sup>32</sup> Field Mus. Nat. Hist.

with *C. r. richardsonii*: Skull averaging slightly larger, with broader rostrum, nasals, and audital bullae; tooth row shorter.

*Color*.—(Type, March 3): Patch on front of face mikado brown (varying in other specimens to wood brown or pinkish cinnamon); head and shoulders smoke gray, shaded with fuscous; eye ring broad, buffy white; back smoke gray shaded with cinnamon buff, the median area darkened with fuscous; feet pinkish buff; tail above, mixed fuscous and pinkish buff, edged with pale buff; tail beneath, sayal brown, tipped with fuscous; lower sides and under parts cinnamon buff, shading to pale buff on chin and throat.

*Measurements*.—Type (♀ ad., from dry skin): Total length, 337; tail vertebrae, 100; hind foot, 47. Average of 9 adults from Ruby Valley, Skelton, and McDermitt, Nev.: Total length, 291.1 (270–307); tail vertebrae, 88.1 (76–100); hind foot, 46.1 (42–48). *Skull*: Average of 6 adults (3 males, 3 females) from Paradise, Metropolis, and McDermitt, Nev.: Greatest length, 47 (44.7–48.6); palatilar length, 23 (22–24); zygomatic breadth, 31.3 (29.9–32.4); cranial breadth, 20.9 (19.6–21.7); interorbital breadth, 10 (9.2–11.6); postorbital constriction, 10.6 (9.7–11.5); length of nasals, 17.7 (17–18.6); maxillary tooth row, 9.6 (9.3–10.3).

*Remarks*.—The Nevada ground squirrel is fully as large as typical *richardsonii* but is grayer and less buffy and the tail is darker and more tawny beneath. It undoubtedly intergrades with *elegans*, but its range as at present known appears to be isolated from the range of that race. It overlaps the range of *oregonus*, occurring often in the same localities, but the two are quite distinct.

*Specimens examined*.—Total number, 33, as follows:

**Idaho**: Riddle (Owyhee County), 1.<sup>33</sup>

**Nevada**: Elko, 9; Metropolis, 5; Mountain City (Elko County), 2; Paradise (Humboldt County), 2; Ruby Valley, 5; Skelton (30 miles south of Elko), 2.

**Oregon**: Malheur County (near McDermitt, Nev.), 4; Rattlesnake Creek (at head, Malheur County), 3.

#### CITELLUS ARMATUS (KENNICOTT)

##### UINTA GROUND SQUIRREL

(Pls. 23, *F*; 28, *F*)

*Spermophilus armatus* Kennicott, Acad. Nat. Sci. Phila. Proc. 1863: 158.

[*Citellus*] *armatus* Trouessart, Cat. Mamm., Sup., p. 339, 1904.

*Cotypes*.—Collected in the foothills of the Uinta Mountains, near Fort Bridger, Wyo., April to June 1858, by C. Drexler; nos. 3464 and 3476, skins [fragmentary] with skulls inside; nos. 4794, 4808, 4809, fragmentary skulls; nos. 5958, 5959, 5960, alcoholics (Lyon and Osgood, 1909, p. 163).

*Range*.—Mountains and foothills of western Wyoming, extreme southwestern Montana, southeastern Idaho, and northern and central Utah; north to Beaverhead, Madison, Gallatin, and Park Counties, Mont.; east to the eastern foothills of the Shoshone and Wind River Mountains, Wyo.; south to Fish Lake Plateau, Utah; west to Donovan, Mont., Mount Harrison, Cassia County, Idaho, and the Raft River Mountains, Utah (fig. 5). *Zonal range*: Canadian and Transition.

*External characters*.—Similar to *C. richardsonii elegans*, but slightly larger, with longer hind feet, tail of nearly the same length; ears larger; upper parts decidedly darker; tail more grayish (less

<sup>33</sup> Mus. Vert. Zool.

buffy) beneath. Compared with *C. beldingi oregonus*: Closely similar in size and coloration, but dorsal region slightly darker, the rump and thighs more tawny (less grayish); tail grayish rather than reddish beneath, the bordering hairs more buffy (less grayish).

*Cranial characters*.—Skull similar to that of *C. r. richardsonii* but averaging slightly longer, and narrower across zygomata; cranium, interorbital region, and rostrum broader, but postorbital constriction less; audital bullae broader, with longer meatus; nasals slightly longer; maxillary tooth row shorter. Compared with *elegans*: Decidedly larger, with broader rostrum and interorbital region, and longer and broader nasals. Compared with *C. r. nevadensis*: Similar in size, but averaging broader across zygomata; brain case and audital bullae broader. Compared with *C. b. oregonus*: Skull slightly larger; nasals averaging broader at posterior end.

*Color*.—(Fresh pelage, June 12): Head, front of face, and ears cinnamon, sprinkled on crown with gray; sides of face and neck pale smoke gray; eye ring cartridge buff; front legs cinnamon buff, shading to pinkish buff on feet; general tone of dorsal area sayal brown or cinnamon buff, the hairs tipped with pinkish buff, bases of the hairs fuscous; sides paler than back, mixed cartridge buff and fuscous; thighs cinnamon; hind feet pinkish buff; tail, above and below, fuscous black, mixed with pale buff or buffy white, and edged with pinkish buff; under parts pinkish buff, shaded with buffy white.

*Variation*.—The intensity of the brownish color on the back varies considerably in different individuals; certain specimens, taken both in midsummer and early spring, have the brownish tone much reduced, the hairs on the median dorsal area being pinkish buff and the whole back and sides washed with grayish white. Two specimens from Mountainview, Wyo., are uniform blackish brown all over.

*Molt*.—The molting period is not clearly shown in the specimens examined, but probably in most individuals the molt occurs in June, or sometimes in May. A male from Hamsfork, Wyo., taken May

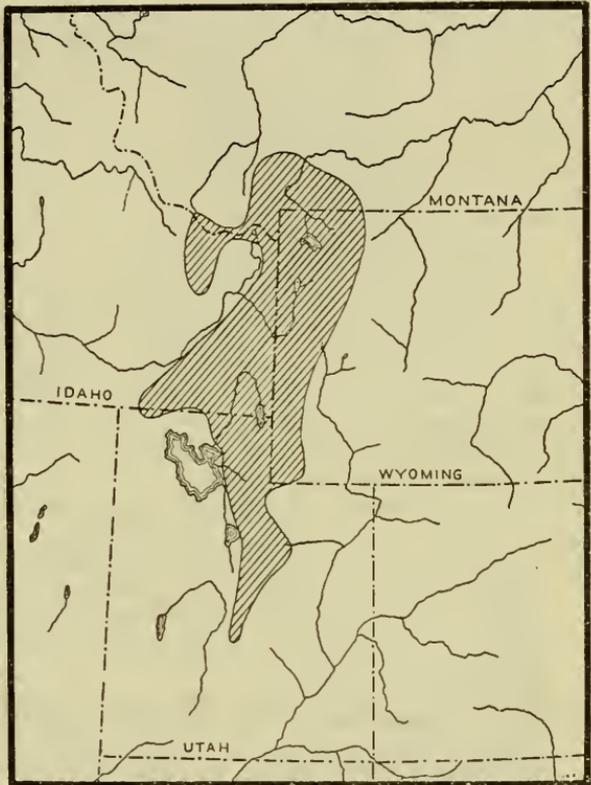


FIGURE 5.—Distribution of *Citellus armatus*.

17, is in badly worn pelage, and shows a few small patches of new hair on the back. A nursing female from Spring Valley, Wyo., June 9, is likewise in a much worn pelage, with new hair covering the head and fore back. An adult male from Cooke, Mont., August 11, shows worn hair on the anterior half of the body and a fuller, unworn pelage on the posterior half.

*Measurements.*—Average of 12 adults from vicinity of type locality: Total length, 294 (280–303); tail vertebrae, 72.6 (63–81); hind foot, 43.9 (42–45.5); ear from notch, 11.2 (10–12). *Skull:* Average of 7 adult males from southwestern Wyoming and Barclay, Utah: Greatest length, 47.8 (46.3–48.5); palatal length, 23.2 (22.5–24); zygomatic breadth, 31 (30–31.8); cranial breadth, 20.7 (19.2–21.5); interorbital breadth, 11 (10–11.3); postorbital constriction, 10.9 (10.4–11.5); length of nasals, 17.8 (16.4–18.4); maxillary tooth row, 9.7 (9.3–10). Average of 6 adult females from Fort Bridger and Spring Valley, Wyo.: Greatest length, 46.5 (45.6–48); palatal length, 22.2 (22–23); zygomatic breadth, 30.2 (29.6–30.8); cranial breadth, 20.1 (19.8–20.4); interorbital breadth, 10.2 (9.4–11.3); postorbital constriction, 11.3 (10–12.3); length of nasals, 17.2 (16.6–17.9); maxillary tooth row, 9.8 (9.4–10.2).

*Remarks.*—The Uinta ground squirrel is a distinct species, occupying a rather limited area in the mountains from southern Montana south to Utah. It most nearly resembles *oregonus*, but the two are quite distinct and so far as known their ranges do not meet. The range of *armatus* meets and slightly overlaps that of *elegans* in parts of Montana and Wyoming, but in general this species occurs at higher altitudes and in more heavily wooded areas than does *elegans*. In some localities, however, as at Pinedale and Cokeville, Wyo., the two species occupy the same ground.

*Specimens examined.*—Total number, 263, as follows:

- Idaho:** American Falls, 1;<sup>85</sup> Arco (Butte County), 4;<sup>86</sup> Big Hole Mountains, 1; Blackfoot, 4; Blackfoot Mountains, 1; Clifton (Franklin County), 1; Elba (Cassia County), 1;<sup>85</sup> Irwin (10 miles southeast, Bonneville County), 5; Malta (Cassia County), 1;<sup>85</sup> Montpelier, 7; Mount Harrison (Cassia County), 1;<sup>85</sup> Pahsimeroi River (head, Custer County), 1;<sup>85</sup> Pocatello, 6; Shelley, 1; Swan Lake (Bannock County), 6; Teton Canyon, 1; Warm River (Fremont County), 1.<sup>81</sup>
- Montana:** Cooke (Park County), 11; Donovan (Beaverhead County), 1; Ennis Lake (Madison County), 2; Lakeview (Beaverhead County), 13; Spanish Creek (Gallatin County), 3; Virginia City (Eight-mile Spring), 4; Virginia City (20 miles south), 3; Ward Peak (Tobacco Root Mountains, Madison County), 6; West Boulder Creek (18 miles southeast of Livingston), 3; West Gallatin River (West Fork, Gallatin County), 4; West Gallatin and Spanish Canyons (Gallatin County), 9.<sup>86</sup>
- Utah:** Barclay (Salt Lake County), 8; Blacksmiths Fork (Cache County), 1; Big Cottonwood Canyon (Salt Lake County), 1;<sup>87</sup> Bountiful, 1; Currant Creek (Wasatch County), 2; Fairview (Mammoth Ranger Station), 2; Farmington, 2; Fish Lake (Sevier County), 1; Fruitland, 3;<sup>41</sup> Hyde Park (Cache County), 1; Laketown (Rich County), 2; Lakota, Bear Lake, 1;<sup>88</sup> Logan Canyon (Cache County), 1;<sup>89</sup> Mantua (Box Elder County), 1;<sup>88</sup> Mount Pleasant, 1; Mount Timpanogas (Utah County), 2;<sup>88</sup> Ogden (Ogden Canyon), 1; Park City, 17; Raft River Mountains, 1;<sup>85</sup> Salt Lake City (Fort Douglas), 3; Sardine Canyon (Cache County), 2;<sup>88</sup> Strawberry Valley (Duchesne County), 9; Wellsville, 4.
- Wyoming:** Afton (Lincoln County), 11; Border (Lincoln County), 5; Clarks Fork (opposite Crandall Creek, Park County), 1; Cokeville, 6; Daniel (Sublette County), 13; Evanston, 4; Fort Bridger, 8; Gros Ventre Mountains

<sup>84</sup> Donald R. Dickey collection.

<sup>85</sup> Mus. Vert. Zool.

<sup>86</sup> Montana State College, Bozeman.

<sup>87</sup> Acad. Nat. Sci. Philadelphia.

<sup>88</sup> Brigham Young Univ.

<sup>89</sup> Utah State Agr. College.

<sup>41</sup> Carnegie Mus.

(Waterdog Lake), 3;<sup>40</sup> Hamsfork (Lincoln County), 2; Jackson, 5; Jakeys Creek (Fremont County), 1; Kemmerer, 7; Kendall (12 miles north, Sublette County), 2; Little Piney Creek (8,000 feet altitude, Sublette County), 1; Merna (Sublette County), 1; Mountainview (Uinta County), 7; Opal (Lincoln County), 2; Pahaska (mouth of Grinnell Creek, Park County), 1; Spring Valley (Uinta County), 2; Stanley (8,000 feet altitude, Sublette County), 1; Valley (Park County), 5; Wind River Mountains (Upper Gros Ventre River, North Fork), 1; Wyoming Peak (10,900 feet altitude, Lincoln County), 1; Yellowstone National Park, 4.

**CITELLUS BELDINGI**  
(MERRIAM)

[Synonymy under subspecies]

*Specific characters.*—Slightly smaller than *C. r. richardsonii*; hind foot, 41–47 mm; tail, 55–76; skull length, 41.3–46.3. Skull similar to that of *C. r. elegans* but relatively longer, and narrower across zygomata, but broader interorbitally; zygomata slenderer; audital bullae smaller. Coloration of upper parts smoke gray, mixed with pinkish buff, the median dorsal area more or less darkened with sayal brown or kaiser brown; under side of tail hazel, upper side mixed with fuscous.

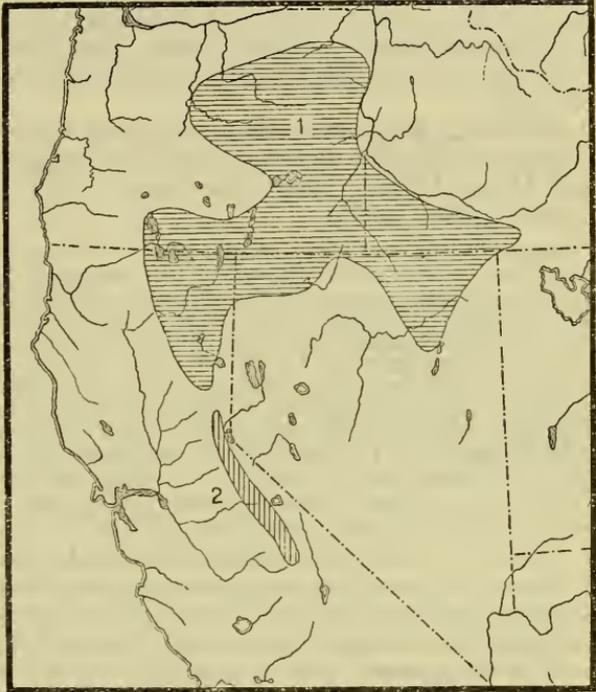


FIGURE 6.—Distribution of the subspecies of *Citellus beldingi*: 1, *C. b. oregonus*; 2, *C. b. beldingi*.

**CITELLUS BELDINGI BELDINGI** (MERRIAM)

BELDING'S GROUND SQUIRREL

(Pls. 3; 23, E; 28, E)

*Spermophilus beldingi* Merriam, Ann. N. Y. Acad. Sci. 4: 317, Dec. 28, 1888.  
[*Citellus*] *beldingi* Trouessart, Cat. Mamm., Sup., p. 339, 1904.

*Type.*—Collected at Donner, Placer County, Calif., June 22, 1886, by Charles A. Allen; female adult, skin and skull, no. 186467, U. S. Natl. Mus. (formerly no.  $\frac{1}{3} \frac{7}{3} \frac{1}{2}$ , Merriam collection) (orig. no. 103).

*Range.*—High mountain meadows in the central Sierra Nevada, from Nevada County (Independence Lake) south to the headwaters of Kings River, Fresno County, Calif. (fig. 6). *Zonal range:* Hudsonian and Canadian, 6,500–11,800 feet altitude (*fide* Grinnell).

*External characters.*—Similar to *C. armatus*, but upper parts darker and more reddish, the reddish color on the back usually in a well defined band; tail reddish instead of grayish beneath.

<sup>40</sup> Cleveland Mus. Nat. Hist.

*Cranial characters.*—Skull similar to that of *C. richardsonii elegans* (as defined under specific characters); smaller than that of *armatus*, with relatively broader interorbital region and less widely expanded zygomata.

*Color.*—Front of face sayal brown, shading to hazel on top of head; sides of face and head mixed fuscous and pinkish buff; eye ring buffy white; nape mixed light buff and hazel; dorsal band (from nape to rump) hazel or kaiser brown (rarely sayal brown); sides of body mixed smoke gray and pinkish buff; feet pinkish buff; thighs cinnamon or sayal brown; tail above mixed hazel and fuscous black; tail beneath, hazel, bordered with tilleul buff and tipped with fuscous black; under parts dull whitish, more or less washed with pinkish buff.

*Molt.*—In the series examined there are no specimens that show clearly when these ground squirrels change their pelage. Grinnell and Dixon (1918, p. 659) consider that the species has but one molt annually, during July.

*Measurements.*—Average of 12 adults (8 males, 4 females) from type locality: Total length, 279.6 (268–296); tail vertebrae, 68 (60–75); hind foot, 44.3 (42–47). *Skull:* Average of 10 adult males from type locality: Greatest length, 45.2 (44–46.3); palatilar length, 21.8 (21–22.7); zygomatic breadth, 28.8 (27.8–29.8); cranial breadth, 19.5 (18.7–20.2); interorbital breadth, 11.2 (10.5–11.9); postorbital constriction, 11.7 (10.9–12.7); length of nasals, 16.9 (16.1–17.5); maxillary tooth row, 9.2 (9–9.4). Average of 10 adult females from type locality: Greatest length, 44.7 (43.2–45.7); palatilar length, 21.8 (21–22.8); zygomatic breadth, 28.9 (28.2–29.6); cranial breadth, 19.5 (19.1–19.8); interorbital breadth, 11.1 (10.7–11.8); postorbital constriction, 11.7 (11.1–12.5); length of nasals, 16.1 (15.2–17.1); maxillary tooth row, 9.5 (9.2–10).

*Weight.*—Average of 10 adult males, 222 g (125.5–285); of 10 adult females, 240 (172–305) (Grinnell and Dixon, 1918, p. 660).

*Remarks.*—Belding's ground squirrel, usually considered to be a distinct species, proves on examination of abundant material to be subspecifically related to *C. beldingi oregonus*. It is rather strictly confined to the alpine meadows in the Sierra Nevada of California, and there appears to be a gap of about 25 miles between its range and that of *oregonus*. Notwithstanding this apparent hiatus between their ranges, there is complete intergradation in characters between the two forms.

*Specimens examined.*—Total number, 236, as follows:

California: Alpine City, Bear Valley (Mariposa County), 1; American River (head of South Fork, near Silver Lake), 2; Bishop Creek (Inyo County), 2; Donner (Placer County, including "Summit"), 97; Diamond Valley (Alpine County), 1; <sup>42</sup>Fredericksburg (Alpine County), 1; <sup>42</sup>Hope Valley (Alpine County), 4; <sup>42</sup>Independence Lake (Nevada County), 13; Johnson Pass (8 miles south of Lake Tahoe), 1; Kaiser Pass (Fresno County), 1; <sup>43</sup>Little Pete Meadow (near head of Middle Fork of Kings River, Fresno County) 1; <sup>44</sup>Long Valley (Mono County), 2; <sup>42</sup>Mammoth (Mono County), 3; McKinneys, Lake Tahoe, 7; Mono Lake, 4; <sup>42</sup>Mono Pass, 3; Mount Dana (Mono County), 3; Mount Conness (Tuolumne County), 1; Mount Tallac (Eldorado County), 2; Owens River (at head), 12; Pine City (Mono County, near Mammoth Pass), 1; Post Corral Meadows (Fresno County), 2; <sup>44</sup>Sand Meadow (Fresno County), 1; <sup>44</sup>San Joaquin River (near Mammoth Pass), 2; Sonora Pass (Alpine County), 2; Tahoe (Placer County), 3; Terrace Meadow (Inyo County), 1; <sup>44</sup>Tioga Pass (Mono County), 1; <sup>42</sup>Walker Lake (Mono County), 1; <sup>42</sup>Woodfords (Alpine County), 5; <sup>42</sup>Yosemite National Park, 52 (including Lake Tenaya, 7; head of Lyell Canyon,

<sup>42</sup> Mus. Vert. Zool.

<sup>43</sup> Wm. T. Shaw Collection.

<sup>44</sup> Cleveland Mus. Nat. Hist.

6; <sup>42</sup> Merced Lake, 1; <sup>42</sup> Mount Hoffman, 4; <sup>42</sup> Mt. Lyell, 1; Mount Unicorn, 1; Porcupine Flat, 2; Tuolumne Meadows, 30); <sup>45</sup> Zonoda Meadow (Inyo County), 1.<sup>44</sup>  
 Nevada: Near Bijou, Calif., 3.

CITELLUS BELDINGI OREGONUS (MERRIAM)

OREGON GROUND SQUIRREL

*Spermophilus oregonus* Merriam, Biol. Soc. Wash. Proc. 12: 69, Mar. 24, 1898.  
 [*Citellus*] *oregonus* Trouessart, Cat. Mamm., Sup., p. 339, 1904.

*Type*.—Collected in Swan Lake Valley, Klamath Basin, Oreg., June 12, 1897, by Vernon Bailey; female adult, skin and skull, no. 89177, U. S. Natl. Mus. (Biological Survey collection) (orig. no. 6005).

*Range*.—Eastern Oregon, northeastern California, southwestern Idaho, and northern Nevada; north to Heppner and Elgin, Oreg.; east to Cassia County, Idaho, and Ruby Valley, Nev.; south to Plumas County, Calif., and Ruby Valley, Nev.; west to Klamath Lake, Oreg., and Goose Nest Mountain, Calif. (fig. 6). *Zonal range*: Upper Sonoran and Transition.

*External characters*.—Similar to *C. b. beldingi*, but averaging slightly smaller; upper parts paler and more grayish, usually without a distinct reddish tone, and never with a well-defined band of reddish brown; similar to *C. richardsonii elegans*, but tail shorter and much darker (more reddish) beneath; coloration above usually darker and more reddish (less yellowish or buffy), with less indication of mottling. Compared with *C. armatus*: Closely similar in size and coloration, but dorsal region paler, the rump and thighs more grayish (less tawny); tail reddish rather than grayish below, the bordering hairs more grayish (less buffy).

*Cranial characters*.—Skull similar to that of *beldingi*, but averaging slightly smaller and relatively narrower interorbitally. Compared with *elegans*: Skull relatively longer and narrower; zygomata weaker and more contracted anteriorly; auditory meatus shorter.

*Color*.—Upper parts smoke gray or pale smoke gray, more or less washed on the back with sayal brown, mikado brown, cinnamon, or light pinkish cinnamon; front of face with a patch of pinkish cinnamon or pinkish buff; under parts and sides washed with pinkish buff, the under fur on belly dusky neutral gray; feet pinkish buff; tail above, cinnamon or sayal brown mixed with smoke gray at base and heavily shaded with black on distal half; tail beneath, hazel, bordered with black and edged with pale tilleul buff.

*Molt*.—Only a very few specimens in the large series examined show definite indications of molt; two adults (male and female) from Howard, Oreg., June 16 and 18, apparently are acquiring new pelage, the new hairs coming in irregularly over the whole back. A female from the Ruby Mountains, Nev., June 20, is in a worn grayish pelage, with a patch of fresh, reddish pelage coming in on the fore back.

*Measurements*.—Average of 10 adult males from southwestern Oregon and northeastern California (Fort Klamath, Po Valley, Burns, Susanville, Tule Lake): Total length, 271.5 (254–300); tail vertebrae, 63.8 (55–76); hind foot,

<sup>42</sup> Mus. Vert. Zool.

<sup>44</sup> Cleveland Mus. Nat. Hist.

<sup>45</sup> Ten in Mus. Vert. Zool.

43 (41-45); average of 8 adult females from southern Oregon and northern California: 276; 67; 42.7. *Skull*: Average of 8 adult males from southwestern Oregon and northern California (Fort Klamath, Tule Lake, Susanville, Madeline Divide): Greatest length, 45 (43.2-46.2); palatilar length, 21.8 (20.5-23); zygomatic breadth, 28.9 (28.1-30.1); cranial breadth, 20.2 (19.8-20.6); interorbital breadth, 10.1 (9.2-10.7); postorbital constriction, 11.7 (10.7-12.3); length of nasals, 16.9 (16-18.2); maxillary tooth row, 9.4 (9-10.1); average of 8 females from same region: Greatest length, 43.1 (41.3-44); palatilar length, 20.8 (19.8-21.5); zygomatic breadth, 27.8 (24.8-29.8); cranial breadth, 19 (18.2-19.5); interorbital breadth, 9.5 (9-10); postorbital constriction, 11.1 (10.4-12); length of nasals, 16.1 (15-17); maxillary tooth row, 9 (8.6-9.3).

*Weight*.—Two specimens weighed by Vernon Bailey registered 1 pound each; one of these was recorded as very fat. Grinnell, Dixon, and Linsdale (1930, p. 483) record six individuals as weighing respectively, 212, 223, 230, 250, 260, and 260 g. Grinnell and Dixon (1918, p. 652) give the average weight of 6 adult females as 302 g (267-365.8).

*Remarks*.—The Oregon ground squirrel is abundant and widely distributed in the Great Basin. It is closely related to *beldingi*, and although the ranges of the two, so far as known, are not actually contiguous, yet the two forms intergrade completely in both the skin and skull characters. In fact, there are numerous specimens in both series that are so near like certain individuals of the other race as to be practically indistinguishable. The distinguishing characters, however, are on the average well marked. The present race is known from specimens as far south in California as Prattville, and its presence has been reported at Red Clover and Mohawk, in Plumas County, whereas *beldingi* is known no farther north than Independence Lake, on the line between Sierra and Nevada Counties, approximately 25 miles southeast of Mohawk.

*Specimens examined*.—Total number, 405, as follows:

**California**: Alturas (10 miles southwest, Modoc County), 7;<sup>46</sup> Bald Mountain (8 miles south, Shasta County), 13; Bieber (Lassen County), 3; Big Meadows (10 miles west, Plumas County), 1;<sup>46</sup> Bull Meadow (Siskiyou County, northeast of Goose Nest Mountain), 1;<sup>45</sup> Bunchgrass Spring (Lassen County), 2; Eagle Lake, 1; Feather River (North Fork, 18 miles east of Warner Creek), 1; Goose Lake, 3; Goose Lake Meadows (near Davis Creek, Modoc County), 2;<sup>46</sup> Goose Nest Mountain (Siskiyou County), 1;<sup>46</sup> Grass Lake (Siskiyou County), 6;<sup>45</sup> Hayden Hill (Lassen County), 1; Horse Lake, 7; Lower Klamath Lake, 1; Macdoel (Siskiyou County), 24;<sup>46</sup> Madeline Divide, 5; Madeline Plains, 1; Mount Hebron (Siskiyou County), 10; Mount Lassen (probably near Black Butte), 6; Petes Valley (Lassen County), 1; Pine Creek (Lassen County), 1; Pit River (North Fork), 4; Pit River (South Fork), 3;<sup>46</sup> Prattville (12 miles northeast), 4; Sugar Hill (Modoc County), 4;<sup>46</sup> Susan River (Lassen County), 5; Susanville, 6; Termo (Lassen County), 1;<sup>45</sup> Tule Lake, 4; Tuledad Canyon (northeastern corner Lassen County), 1; Warner Mountains, 6; Westwood (15 miles west, Lassen County), 1.

**Idaho**: Elba (Cassia County), 1;<sup>46</sup> Hollister (Twin Falls County), 1;<sup>46</sup> Malta (Cassia County), 1;<sup>46</sup> Mount Harrison (Cassia County), 1;<sup>46</sup> Riddle (15 miles southeast, Owyhee County), 1; Silver City, 8; Sinker Creek (Owyhee County), 25.

**Nevada**: Badger (20 miles northwest of Summit Lake, Humboldt County), 4; Calico Mountain (northeastern Humboldt County), 2; Halleck (Elko County), 1; Massacre Creek (Washoe County), 1;<sup>46</sup> Mountain City (Elko County), 12; Pine Forest Mountains, 12;<sup>46</sup> Ruby Mountains, 1; Ruby Valley, 10.

**Oregon**: Austin (Grant County), 2; Baker (10 miles north), 3;<sup>46</sup> Barnes (Crook County), 3;<sup>46</sup> Bear Creek (15 miles northwest of Dayville, Grant County), 1;<sup>46</sup> Beech Creek (Grant County), 2; Beulah (Malheur County), 13; Bu-

<sup>45</sup> Ten in Mus. Vert. Zool.

<sup>46</sup> Mus. Vert. Zool.

<sup>46</sup> Univ. Michigan Mus. Zool.

chanan (Harney County), 6; Buck Creek (Crook County), 1; Burns, 2; Camas Prairie, east of Lakeview, 5;<sup>49</sup> Cedar Mountains, 1; Diamond (Harney County), 5; Disaster Peak (Malheur County), 1; Drewsey (Harney County), 1; Elgin, 6; Fort Klamath, 23; Harney (10 miles north), 4; Haycreek (Jefferson County), 13; Heppner, 15; Home (Baker County), 10; Howard (Crook County), 4; Jordan Valley (Malheur County), 5; Joseph (Wallowa County), 7; Klamath Falls, 3; Lakeview, 1; Lone Rock (6 miles east, Gilliam County), 1; Lost River, Klamath Basin, 1; Mahogany Mountain (Malheur County), 3; Malheur County, near McDermitt, Nev., 3; Malheur Lake, 1; Maury Mountains (Crook County), 1; Meacham (10 miles south, Umatilla County), 1; Mount Vernon (Grant County), 2; Mount Warner (=Hart Mountain, Lake County), 2; Narrows (Harney County), 4; Po Valley (Lost River, Klamath County), 1; Prineville, 7; Rattlesnake Creek (at head, Malheur County), 1; Rockville (Malheur County), 1; Shirk (Harney County), 1; Steens Mountains, 13; Swan Lake Valley (Klamath County), 2; Telocaset (Union County), 2; Twickenham (Wheeler County), 2; White Horse Creek (Harney County), 1.

#### CITELLUS PARRYII GROUP

#### CITELLUS COLUMBIANUS (ORD)

[Synonymy under subspecies]

*Specific characters.*—Larger than *C. richardsonii* or *C. armatus*; hind foot, 48–58 mm; tail, 80–116; skull length, 49.5–57. Skull relatively longer than that of *richardsonii*, the zygomata less widely expanded posteriorly; dorsal outline much flatter, the highest point behind the postorbital processes, the rostrum not sharply depressed; interorbital region relatively broad and flat, the supraorbital margins not elevated or thickened; rostrum and nasals longer; upper tooth rows nearly parallel; audital bullae large but not greatly elevated; meatus slightly produced.

*Color.*—Nose and face tawny or hazel; occiput, nape, and sides of neck smoke gray; upper parts cinnamon buff or sayal brown, shaded with fuscous and in winter with smoke gray; hind legs and feet tawny or hazel; front feet ochraceous buff; tail gray or tawny; under parts ochraceous buff or tawny.

#### CITELLUS COLUMBIANUS COLUMBIANUS (ORD)

#### COLUMBIAN GROUND SQUIRREL

(Pls. 4; 24, A; 29, A)

*Arctomys columbianus* Ord, Guthrie's Geography (2nd Amer. ed.), 2: 292 (description, p. 303), 1815.

*Anisonyx brachiura* Rafinesque, Amer. Monthly Mag. 2: 45, 1817.

*Arctomys brachyura* Harlan, Fauna Americana, p. 304, 1825.

*Arctomys brachyurus* Richardson, Fauna Boreali-Americana, p. 151, 1829.

*Arctomys parryi* var. *β*, *erythrogluteia* Richardson, Fauna Boreali-Americana, p. 161, 1829 ("Rocky Mountains, near the sources of the Elk River"=Wolf Plain, 30 miles west of Rock Lake, Alberta).<sup>50</sup>

[*Spermophilus parryi*] var. *erythrogluteia* Allen, Boston Soc. Nat. Hist. Proc. 16: 292, 1874.

*Spermophilus empetra* var. *erythrogluteus* Allen, Monog. North Amer. Rodentia, p. 839, 1877 (part).

*Spermophilus columbianus* Merriam, North Amer. Fauna 5: 39, 1891.

*Citellus columbianus* Allen, Amer. Mus. Nat. Hist. Bull. 19: 536, 1903.

*Citellus columbianus albertae* Allen, Amer. Mus. Nat. Hist. Bull. 19: 537, 1903 (Canadian National Park, Alberta).

*Citellus (Colobotis) columbianus* Preble, North Amer. Fauna 27: 164, 1908.

<sup>49</sup> Carnegie Mus.

<sup>50</sup> See remarks, p. 88.

*Type*.—None designated; original description based on Lewis and Clark's description of animals taken by them on a camas prairie between the forks of the Clearwater and Kooskooskie Rivers, Idaho.

*Range*.—Rocky Mountain region of western Montana, Idaho, northeastern Washington, southeastern British Columbia, and western Alberta; also the plains of eastern Washington and mountains

of east-central Oregon (exclusive of the Blue Mountains); north to the headwaters of South Pine River, British Columbia (reported by William Fox from this locality and from mountains on east side of the lower Parsnip River); south to Craters of the Moon, Butte County, Idaho, and Harney County, Oreg.; east to Cutbank and Townsend, Mont.; west to Shuswap and Okanagan Lake, British Columbia, Oroville, Wash., and Snow Mountain, head of Silver Creek, Harney County, Oreg. (fig. 7). *Zonal range*: Canadian and Hudsonian.

*External characters*.—As given under specific characters (p. 85); in comparison with *C. parryi plesius*, upper parts not distinctly spotted; sides of neck gray instead of buff; hind feet and legs darker (tawny or hazel instead of cinnamon buff); tail edged with



FIGURE 7.—Distribution of the subspecies of *Otellus columbianus*: 1, *C. c. columbianus*; 2, *C. c. ruficaudus*.

white instead of buff; tail averaging longer and hind feet shorter.

*Cranial characters*.—As given (p. 85) in comparison with *C. richardsonii richardsonii*. Compared with *plesius*: Skull averaging smaller and relatively narrower, the superior outline flatter (less convex); rostrum longer and narrower; supraorbital shelf not elevated; palate longer, its posterior border considerably behind plane of last molars; posterior loph of  $m^3$  low and sometimes discontinuous.

*Color*.—*Summer pelage*: Nose and front of face tawny or hazel;

crown mixed cinnamon buff and smoke gray; occiput, nape, and sides of neck pale smoke gray; eye ring pale buff; ears hair brown on outer surface, buffy or tawny on inner surface; general tone of upper parts cinnamon buff or sayal brown, more or less shaded with the darker color of the under fur, which is fuscous or hair brown; sides washed with grayish or buffy white; under parts cinnamon buff or ochraceous buff; front legs and feet ochraceous buff; hind feet ochraceous tawny, the thighs hazel; tail above, black, rather heavily overlaid with grayish white and sparingly sprinkled with cinnamon buff or tawny; tail beneath, mixed fuscous black and grayish white. *Winter pelage* (March and April): Similar to the summer pelage but upper parts more heavily sprinkled with grayish.

*Variation*.—Two albinistic juvenile individuals were taken at Pullman, Wash., May 10, 1906; Svihla (1933, p. 78) reports seeing three albino individuals there in 1933.

*Molt*.—The annual molt occurs in June or July. A female taken at Ketchum, Idaho, June 6, is in a badly worn pelage, with new hair appearing on the forehead; another female (subad.) from Columbia Falls, Mont., June 27, shows new pelage covering the head and median dorsal region, nearly to the rump; an adult female from Nelson, British Columbia, July 18, shows a patch of fresh summer pelage on the middle of the back; an adult female from Piegan Pass, Mont., is in a much worn pelage, with new hair appearing on the head and nape; a juvenile from Silver, Mont., June 26, was acquiring a new pelage in patches on the head and back. In the large series examined no evidence has been found that would indicate a molt in the autumn.

*Measurements*.—Average of 12 adults (6 males, 6 females) from Idaho: Total length, 349.7 (327-377); tail vertebrae, 100.5 (83-116); hind foot, 51.2 (48-55). *Skull*: Average of 10 adult males from Idaho: Greatest length, 51.7 (50-56); palatilar length, 25.1 (24-27); zygomatic breadth, 31.8 (30.5-33.8); cranial breadth, 20.8 (19.6-21.8); interorbital breadth, 10.6 (9.9-12); postorbital constriction, 11.3 (10.4-12.5); length of nasals, 19.4 (18-21.4); maxillary tooth row, 10.9 (10.1-11.8). Average of 7 adult females from Idaho: Greatest length, 50.7 (49.5-51.9); palatilar length, 24.8 (23-26); zygomatic breadth, 32.2 (31.6-33.6); cranial breadth, 21 (20.5-21.4); interorbital breadth, 11.2 (10.2-12); postorbital constriction, 12 (11.4-12.2); length of nasals, 18.7 (18-19.4); maxillary tooth row, 11 (10.4-11.6).

*Weight*.—Shaw (1926a, p. 137) gives the weights of two males taken in late July as 589 and 830 g, respectively; eight males taken from the hibernation den at time of awakening averaged 492 g (435-571); two males running at large on March 10, after hibernation, weighed respectively, 341 and 375 g. Two females taken when going into hibernation weighed respectively, 414 and 500 g (Shaw, 1925i, p. 764).

*Remarks*.—The Columbian ground squirrel is quite distinct from any other species and its range apparently does not meet that of *C. parryii plesius* in British Columbia. The latter reaches its southern limit in the vicinity of Tatletuey Lake, and *columbianus* ranges no farther north than the mountains lying east of Parsnip River and south of Peace River, thus leaving a gap of 160 miles or more unoccupied by ground squirrels of this group. In Montana and southern Idaho, this species is apparently extending its range eastward and southward, doubtless attracted from its natural home in the mountain meadows to the cultivated fields in the valleys.

The form occupying the Blue Mountains region of Oregon and Washington is recognized as a subspecies, but nearly typical *columbianus* occurs in the low mountains south of this area and probably

in all the surrounding foothills. Two adult specimens from mountains 10 miles north of Harney and 3 miles from Ironsides, Oreg., are intermediate, agreeing in color with *columbianus* and in skull characters with *C. c. ruficaudus*.

Although discovered by Lewis and Clark in their epochal journey across the continent in 1804-6 and described by Ord in 1815, this species was very imperfectly known for many years, and the name *columbianus* was misapplied to the plateau prairie dog (*Cynomys gunnisoni*).

Richardson, 1829, named a ground squirrel procured by Drummond in the Canadian Rockies as a variety of the Parry ground squirrel—*Arctomys parryi* var.  $\beta$ , *erythrogluteia*. Allen (1877) adopted Richardson's name, listing under it two specimens from the head of Flathead River and two from Kootenay River—both localities in southeastern British Columbia. Merriam (1891, p. 39), having procured specimens from the vicinity of the type locality of *columbianus*, cleared up the situation, showing that the "burrowing squirrel" of Lewis and Clark was actually a ground squirrel, and that the names *columbianus* and *erythrogluteia* referred to the same species.

Allen, however, in 1903, revived the name *erythrogluteia* and applied it to the form of *parryi* occurring on the head of Telegraph Creek and Sheslay River, British Columbia, which he recognized as distinct from *columbianus* and which had been named *plesius* by Osgood in 1900. This assignment of *erythrogluteia* was made on the assumption that the type locality—Elk River, Rocky Mountains—is in latitude 57° N., as stated by Richardson in the original description, and therefore not far from the Telegraph Creek region. This however, was an error, for as Preble has shown (1908, p. 164), the "Elk River" of Richardson is the Athabaska, and its sources are between 52° and 54° N. Richardson's species—*erythrogluteia*—was based on specimens collected by Thomas Drummond and the type locality is determined by a reading of Drummond's sketch of his journey published in Hooker's Botanical Miscellany (1830, p. 178). On page 212 of this publication he speaks of finding *Arctomys parryi* abundant "on the mountains near the Wolf's Plain" and states that specimens were "brought home." On page 199 he gives the location of Wolf Plain as "about 30 miles west from Lac-la-Pierre" (=Rock Lake). Rock Lake is about 25 miles northwest of the lower end of Jasper Lake. This would fix the type locality of *erythrogluteia* as near the headwaters of Sulphur River, a branch of Smoky River. Specimens of this animal were taken by J. Alden Loring in 1895, on Smoky River, a short distance from this locality, and, as already stated, they prove to be indistinguishable from typical *columbianus*.

Examination of a series from Canadian National Park that formed the basis of Allen's "*albertae*" shows their characters to be too slight and inconstant to admit of recognition in nomenclature. The skulls average slightly larger and flatter than those of typical *columbianus* and the jugal averages broader, but these characters are not constant in the series of 10 skulls examined; the shape of the antorbital foramen varies from triangular to circular.

*Specimens examined.*—Total number, 351, as follows:

- Alberta:** Banff, 6; [Rocky Mountains] 75 miles southwest of Calgary, 1;<sup>51</sup> Canadian National Park, 3;<sup>51</sup> Crows Nest (Livingstone River), 1;<sup>52</sup> Crows-nest Pass, 1;<sup>52</sup> Hay River (near head), 1; Henry House (25 miles west), 1; Jasper Park, 13;<sup>51, 52</sup> Mount Forgetmenot, 4;<sup>52</sup> Ptarmigan Lake, 3;<sup>51</sup> Silver City, 2;<sup>52</sup> Smoky Valley (50 miles north of Jasper House), 7; Sulphur River (upper), 2; Waterton Lake Park, 5.<sup>52</sup>
- British Columbia:** Barkerville, 1;<sup>53</sup> Cascade, 6;<sup>52</sup> Cranbrook, 9;<sup>53</sup> Deer Park, 2;<sup>52</sup> Fernie, 1;<sup>52</sup> Indianpoint Lake, 2;<sup>53</sup> Midway, 4;<sup>52</sup> Mount Queest, 2;<sup>52</sup> Nelson, 12; Okanagan, 4;<sup>53, 54</sup> Okanagan Falls, 2;<sup>55</sup> Shuswap, 4;<sup>53</sup> Shuswap River (headwaters, Gold Range), 1; Spillimachene River, 3.<sup>51</sup>
- Idaho:** Bald Mountain Ranger Station (10 miles south of Idaho City), 2; Bitter-root Mountains, 1;<sup>51</sup> Coeur d'Alene, 9; Edna (15 miles northeast of Idaho City), 4; Forney, 2; Fort Sherman (near Coeur d'Alene), 2; Galena (30 miles north of Ketchum), 9; Goodrich (Adams County), 3; Idaho City, 5; Ketchum, 17; Lardo (Valley County), 1; McKinnis (7 miles east, Shoshone County), 1;<sup>55</sup> Moscow, 38; Mullan, 5; New Meadows (Adams County), 2; Nez Perce, 2; Packer Meadow (south of Lolo Hot Springs), 4; Seven Devils Mountains, 2; Shafer Butte (Boise County), 6;<sup>56</sup> Tamarack (Adams County), 1; Troy, 1;<sup>54</sup> Warren (Idaho County), 1.
- Montana:** Bass Creek (northwest of Stevensville), 1; Carroll (Deerlodge County), 6; Columbia Falls, 8; Corvallis, 4; Deerlodge County, 1;<sup>51</sup> Flat-head Lake (north end), 2; Flathead River (at International Boundary), 2; Florence, 7; Gibbon Pass (Beaverhead County), 8;<sup>57</sup> Hamilton, 3;<sup>54</sup> Helena, 3; Kalispell, 4; Lolo, 3; McDermott Lake, 3; Nyack (Flathead County), 4; Piegan Pass (Glacier National Park), 1; Prospect Creek (near Thompson Falls), 1; St. Mary, 2;<sup>54</sup> Silver (=Saltese, Missoula County), 4; Sula, 1; Thompson Falls, 1; Tobacco Plains (=Gateway, Lincoln County), 1; Willow Creek (7 miles east of Corvallis), 1; Wisdom (20 miles north, Beaverhead County), 4.<sup>57</sup>
- Oregon:** Harney (10 miles north), 4; Ironside (Malheur County), 3;<sup>51</sup> Strawberry Mountains, 3.
- Washington:** Calispell Lake (Pend Oreille County), 1; Calispell Peak, 2; Cheney, 2; Colfax, 1; Colville, 16; Gifford (Stevens County), 2; Loon Lake (Stevens County), 6;<sup>54</sup> Pullman, 4; Spokane, 8; Sullivan Lake (Pend Oreille County), 2; Williams Lake (Spokane County), 1.<sup>54</sup>

#### CITELLUS COLUMBIANUS RUFICAUDUS HOWELL

##### BLUE MOUNTAINS GROUND SQUIRREL

*Citellus columbianus ruficaudus* Howell, Biol. Soc. Wash. Proc. 41: 212, Dec. 18, 1928.

*Type.*—Collected at Wallowa Lake, Wallowa County, Oreg., April 13, 1919, by George G. Cantwell; female adult, skin and skull, no. 231942, U. S. Natl. Mus. (Biological Survey collection) (orig. no. 1093).

*Range.*—The Blue Mountains region of Oregon and Washington, from Prescott and Dayton, Wash., south to Dixie Butte, Grant County, Oreg.; east to the Wallowa Mountains, Oreg. (fig. 7). *Zonal range:* Canadian and Hudsonian.

*External characters.*—Similar to *C. c. columbianus*, but upper side of tail tawny (not gray); sides of face and usually the throat a deeper shade of tawny; legs and feet darker; hind feet longer.

*Cranial characters.*—Skull similar to that of *columbianus*, but larger and relatively broader; zygomata more heavily built, the jugal wider.

<sup>51</sup> Amer. Mus. Nat. Hist.

<sup>52</sup> Nat. Mus. Canada.

<sup>53</sup> Provincial Mus., Victoria, B. C.

<sup>54</sup> Univ. Michigan Mus. Zool.

<sup>55</sup> Donald R. Dickey coll.

<sup>56</sup> Cleveland Mus. Nat. Hist.

<sup>57</sup> Montana State College.

*Color*.—*Summer pelage* (May 28): Forehead and face hazel; sides of nose and throat ochraceous buff or ochraceous tawny; eye ring broad, pinkish buff; occiput cinnamon buff, more or less mixed with smoke gray and fuscous; sides of neck (beneath eyes) and an indistinct band across nape, smoke gray; dorsum cinnamon buff grizzled with fuscous; sides smoke gray, mixed with fuscous; front legs and feet tawny or ochraceous tawny; hind feet deep tawny, the thighs russet; tail above, deep tawny, the hairs banded subterminally with fuscous black and cinnamon buff; tail beneath, mixed tawny and smoke gray; under parts clay color or cinnamon buff, shading to ochraceous tawny on throat. *Winter pelage* (April 13): Similar to the summer pelage, but upper parts pale smoke gray, mixed with pinkish buff and grizzled with fuscous; feet slightly paler tawny.

*Molt*.—A female specimen from the Blue Mountains, Wash. (3,000 feet altitude), June 16, is in badly worn condition, with new hair appearing on the head and nape.

*Measurements*.—Average of 10 adults (8 males, 2 females) from the Wallowa Mountains, Enterprise, Elgin, and Bourne, Oreg.: Total length, 369.6 (340–410); tail vertebrae, 100.7 (80–115); hind foot, 54.2 (51–58). *Skull*: Average of 8 males (ad. and subad.) from same localities: Greatest length, 54.2 (51.5–57); palatilar length, 26.6 (24.5–28); zygomatic breadth, 34.1 (33.2–35.6); cranial breadth, 21.9 (21.5–22.4); interorbital breadth, 12.4 (11.1–14.3); postorbital constriction, 11.9 (10.5–12.6); length of nasals, 19.8 (18.8–20.3); maxillary tooth row, 11.4 (10.5–12.4). Average of 4 females from same region: Greatest length, 52.9 (50.7–54.7); palatilar length, 25.7 (24.5–27.5); zygomatic breadth, 33.3 (31.2–34.6); cranial breadth, 21.3 (20.4–21.7); interorbital breadth, 12.5 (11.5–13.2); postorbital constriction, 12.1 (11.9–12.3); length of nasals, 19.3 (18.7–19.7); maxillary tooth row, 11.3 (11–11.8).

*Remarks*.—This race is restricted to the Blue Mountains region of northeastern Oregon and southeastern Washington; it intergrades with *columbianus* in the Strawberry Mountains and on the southern slopes of the Burnt River Mountains, Oreg.

*Specimens examined*.—Total number, 69, as follows:

**Oregon**: Anthony (6 miles southwest of Cornucopia), 16;<sup>58</sup> Austin (Grant County), 1; Bourne (Baker County), 3; Cornucopia (Baker County), 7; Dixie Butte (Grant County), 6; Elgin, 5; Enterprise, 2; Joseph, 1;<sup>59</sup> Meacham, 4; Wallowa Lake, 7.

**Washington**: Anatone (Asotin County), 2; Blue Mountains (21 miles south-east of Dayton), 4; Dayton, 4;<sup>59</sup> Prescott, 7.<sup>60</sup>

#### CITELIUS PARRYII (RICHARDSON)

[Synonymy under subspecies]

*Specific characters*.—Size medium to large; hind foot, 50–68 mm; tail, 77–138; skull length, 50.7–65.7. Skull heavily built and angular, its superior outline convex, highest at plane of postorbital processes; the rostrum and brain case moderately depressed; zygomata broad and heavy, widely spreading and strongly twisted from the vertical plane; postorbital processes heavy, depressed, directed slightly backwards; supraorbital shelf thickened and elevated; nasals broad, ending about even with premaxillae; antorbital canal large, orbicular, with a pronounced process at its anterior opening; audital bullae broad, moderately inflated, the meatus tube moderately produced; molariform teeth heavy, the anterior upper premolar ( $p^3$ )

<sup>58</sup> Amer. Mus. Nat. Hist.

<sup>59</sup> Univ. Michigan Mus. Zool.

<sup>60</sup> Mus. Vert. Zool.

one-third to nearly one-half of  $p^4$ ; posterior loph on  $m^3$  well developed (but lower than anterior loph) and continuous (not broken by a sulcus in middle); incisors relatively slender and projecting forward.

*Color*.—Head tawny or cinnamon; rest of upper parts reddish brown, cinnamon, or fuscous, more or less abundantly flecked with rather large whitish fuscus; under parts ochraceous tawny to cinnamon buff in summer pelage, ochraceous buff or grayish white in winter; sides of head and body buff or tawny in summer, becoming smoke gray in winter; feet and legs tawny, ochraceous buff, or cinnamon; tail above, ochraceous tawny, cinnamon, or cinnamon buff, more or less mixed with fuscous black; tail beneath, russet or tawny.



FIGURE 8.—Distribution of the species and subspecies of the *Citellus parryii* group: 1, *C. p. parryii*; 2, *C. p. barrowensis*; 3, *C. p. plesius*; 4, *C. p. ablusus*; 5, *C. p. nebulicola*; 6, *C. kodiakensis*; 7, *C. osgoodi*; 8, *C. p. lyratus*.

### CITELLUS PARRYII PARRYII (RICHARDSON)

#### PARRY'S GROUND SQUIRREL

*Arctomys parryii* Richardson, Appendix to Parry's Second Voyage, p. 316, 1825 (1827).

*Spermophilus parryii* Lesson, Manuel de Mamm., p. 244, 1827.

*Arctomys (Spermophilus) parryi* Richardson, Fauna Boreali-Amer. 1: 158, 1829.

*Arctomys parryi* var. *phacognatha* Richardson, Fauna Boreali-Amer. 1: 161, 1829 (Hudson Bay).

*A[rctomys] kennicottii* Ross, Canad. Nat. & Geol. 6: 434, 1861 (Fort Good Hope, Mackenzie).

*Spermophilus empetra* Allen, Monog. North Amer. Rodentia, p. 839, 1877 (not *Mus empetra* Pallas).

*Spermophilus parryi* Preble, North Amer. Fauna 22: 46, 1902.

*Citellus parryii* Miller and Rehn, Boston Soc. Nat. Hist. Proc. 31: 75, 1903.

*Citellus (Colobotis) parryi kennicottii* Preble, North Amer. Fauna 27: 162, 1908.

*Citellus (Colobotis) parryi* Preble, in Seton, The Arctic Prairies, app. F., p. 342, 1911.

*Citellus parryi kennicottii*, Hall, Calif. Univ. Pubs., Zool. 30: 423, 1929.

*Type*.—None designated; description based on specimens collected at Five Hawser Bay, Lyon Inlet, Melville Peninsula, Hudson Bay, Canada.

*Range*.—Barren Grounds of northern Canada from Melville Peninsula and western shores of Hudson Bay west to northwestern Yukon

and northeastern Alaska; south to Rampart House on Alaska-Yukon boundary, Artillery Lake, Mackenzie, and a point about 25 miles south of Cape Eskimo, Hudson Bay<sup>61</sup> (fig. 8). *Zonal range*: Arctic.

*External characters*.—Size large; entire head (in summer) tawny or russet; upper parts brownish, more or less mixed with gray and flecked with large, irregular, whitish spots; tail russet beneath, edged with cinnamon; under parts tawny; winter pelage much paler and more whitish, the under parts ochraceous buff or grayish white.

*Cranial characters*.—As given under specific characters (p. 90); skull large, equaling that of *C. osgoodi*; much larger than that of *C. p. plesius*; temporal ridges uniting in adults to form a prominent sagittal crest.

*Color*.—*Summer pelage* (Hudson Bay, 25 miles south of Cape Eskimo, August): Top of head (nose to occiput) russet or tawny; sides of nose and face cinnamon buff or ochraceous buff; eye ring (often indistinct) pinkish buff or cartridge buff; sides of neck tawny, shaded with fuscous black; dorsum russet or bister, abundantly flecked with rather large, irregular spots of creamy white or buffy white; front and hind legs tawny or ochraceous tawny, the feet ochraceous buff; under parts ochraceous tawny, becoming cinnamon buff on the throat; tail above, blackish, shaded on proximal half with ochraceous tawny or hair brown and sparingly edged with ochraceous tawny or avellaneous; tail beneath, russet, widely bordered at tip with blackish. *Winter pelage* (Dolphin and Union Strait, Arctic coast, May): General tone of upper parts pale smoke gray, sparingly sprinkled with black hairs and shaded with sayal brown in the middle of the back; top of head and face cinnamon or pinkish cinnamon; under parts pinkish buff or ochraceous buff; tail above, smoke gray, mixed with cinnamon buff, the tip blackish; legs and feet pinkish buff, pinkish cinnamon, or ochraceous buff.

*Variation*.—Several young specimens from Artillery Lake, Mackenzie (U. S. Natl. Mus. nos. 180894, 180895, Aug. 2-6), differ from Hudson Bay specimens taken at the same season in having the back of a grayish tone, produced by a mixture of fuscous and grayish white. An adult (no. 180922) from the same locality, but without date, is of the normal brownish color. A series of subadult specimens from Clinton Colden Lake and Thelon River, Mackenzie, taken in early August, are in worn pelage distinctly paler and more grayish than the August specimens from the coast of Hudson Bay. An adult from Collinson Point, on the north coast of Alaska (Sept. 30) has the under parts grayish white, very faintly washed with pale pinkish buff; others from the same section at the same season have the under parts partly white and partly ochraceous buff. Several summer specimens from Cape Fullerton, Hudson Bay, have the head and sides of neck heavily washed with bay or chestnut and others from the northeast coast of Alaska have a less intense

<sup>61</sup>A specimen in the National Museum of Canada, collected by Owen O'Sullivan and labeled as from "Lat. 53° N., Long. 83° W." indicates a southward extension of the animal's range to a point on the west side of James Bay; Dr. R. M. Anderson has kindly looked up the records of O'Sullivan's trip (Canada Geol. Survey Summary Rept., 1908, no. 1072, 1909, p. 93) and he finds no reason to doubt that the specimen was taken at the point indicated by the label. In view of the fact, however, that other explorers have failed to find any evidence of the occurrence of this species at either Fort Churchill or York Factory, the record from James Bay is most surprising, and suggests the possibility of error.

wash on the head and a broad streak of chestnut on the middle of the belly.

*Molt.*—The spring molt takes place chiefly in June but the process is clearly shown by only a few of the specimens examined. An adult male from Firth River, Alaska-Yukon boundary, June 24, 1912, is in badly worn winter pelage, with the new summer pelage showing in patches on the nape and back; another adult male from U Creek, Alaska, June 27, shows new pelage covering the head, fore legs and portions of the belly. An adult female from Old Fort Good Hope, June 27, is acquiring a fresh pelage of a grayish tone on the upper parts, the under parts apparently in complete summer pelage, but the tail hairs not fully renewed. An adult female from Clinton Colden Lake, Mackenzie, August 2, is in greatly worn pelage, with new hair of a grayish tone coming in on the shoulders, and patches of new buffy hair on the under parts. The fall molt occurs in September or October, and as usual in this genus, the change is obscurely indicated. Two specimens from Collinson Point, Alaska, taken September 22 and 24, 1913, show the winter pelage covering the head, shoulders, fore back, and most of the under parts, the moderately worn summer pelage still remaining on the hinder back and on the middle of the belly.

*Measurements.*—Average of 8 adult males from the Arctic coast of Mackenzie (Coronation Gulf to Franklin Bay): Total length, 443 (420-495); tail vertebrae, 124 (115-136); hind foot, 65.6 (63-68). Average of 5 adult females from same localities: Total length, 414 (390-430); tail vertebrae, 122.6 (98-138); hind foot, 59.2 (57-61). Average of 9 adult males from Aylmer and Clinton Colden Lakes and near Cape Eskimo, Mackenzie: Total length, 400 (380-430); tail vertebrae, 125 (115-140); hind foot, 63.6 (60-66). *Skull:* Average of 6 adult males from west coast of Hudson Bay (Cape Fullerton and Cape Eskimo) and Aylmer and Clinton Colden Lakes, Mackenzie: Greatest length, 60.9 (60-62.2); palatilar length, 31.2 (30.3-32.5); zygomatic breadth, 40.2 (39.3-42); cranial breadth, 24.7 (23.5-25.5); interorbital breadth, 13.4 (12.9-13.8); postorbital constriction, 13.4 (12.7-14.1); length of nasals, 23.6 (21.9-25.1); maxillary tooth row, 13.6 (13.2-14.1). Average of 4 old adult males from Dolphin and Union Strait, Arctic coast: Greatest length, 64.3 (63.3-65.7); palatilar length, 33.2 (33-33.5); zygomatic breadth, 42.8 (40.6-44.1); cranial breadth, 25.4 (24.7-26.4); interorbital breadth, 14.9 (14.3-15.6); postorbital constriction, 12.9 (12.4-13.3); length of nasals, 25 (23.7-25.9); maxillary tooth row, 14.1 (13.7-14.3). Average of 6 adult females from west coast of Hudson Bay and interior Mackenzie: Greatest length, 57.5 (55.4-59.5); palatilar length, 29.6 (29-30.5, 3 specimens); zygomatic breadth, 37.6 (35.8-39.4); cranial breadth, 23.5 (22.8-24.2); interorbital breadth, 12.9 (12.5-13.4); postorbital constriction, 13.4 (11.7-14.3); length of nasals, 21.5 (20-22.9); maxillary tooth row, 13.3 (12.4-13.7). Average of 4 old adult females from Arctic coast (Dolphin and Union Strait and Coronation Gulf): Greatest length, 61.2 (60.7-62.1); palatilar length, 31.9 (31.5-32); zygomatic breadth, 40.9 (40.5-41.5); cranial breadth, 24.5 (24.2-24.9); interorbital breadth, 13.6 (12.9-14.4); postorbital constriction, 13.1 (12.2-13.7); length of nasals, 23.4 (23.2-24); maxillary tooth row, 13.8 (13.4-14.2).

*Weight.*—A male taken at Collinson Point, Alaska, September 9, weighed 2 pounds, 4 ounces; another male from the same locality, September 7, weighed 2 pounds, 8 ounces; and a female taken there October 2, weighed 1 pound, 9 ounces.

*Remarks.*—Although described more than a hundred years ago, this large ground squirrel, until recently, has been imperfectly known and poorly represented in collections. Even now, although a series of over 100 specimens has been brought together, there is a lack of material in unworn summer pelage, which fact makes it difficult to describe the pelage variations. The species exhibits a very con-

siderable amount of both individual and seasonal variation and from only a few localities are there unworn specimens illustrating both the summer and the winter pelages. Specimens in fresh winter pelage are lacking from Hudson Bay and the entire region east of Coronation Gulf. A series from Cape Fullerton, Hudson Bay—some 225 miles southwest of the type locality—undoubtedly represents the typical form. These are without date of capture (excepting one marked October) but apparently were taken in late summer (August or September). Most of them show considerable wear. Two adults in slightly worn summer pelage and two full grown young of the year in unworn pelage taken near Cape Eskimo, Hudson Bay, August 10 and 11, 1900, are slightly darker above than the average of the Cape Fullerton specimens, the back less strongly flecked with whitish spots. These Cape Eskimo specimens, however, are considered typical and have been used in making comparisons; they may be very closely matched in a large series taken in July and August on Firth River, northwestern Yukon, about 45 miles from the Arctic coast. The skulls of these Yukon specimens average slightly smaller than the series from Hudson Bay but are essentially like them in their characters.

Variation in size of skull is extreme in this species. Eight very old specimens (four males, four females) in a series from the vicinity of Coronation Gulf, Arctic coast, are decidedly larger than any others examined. Probably this excessive size is due to the age of the animals, and a larger series, including some subadults, would doubtless show a smaller average. Nine adult males of a series from Firth River, on the Alaska-Yukon boundary (which, as stated above, agree in color with *parryii* from Hudson Bay) average slightly smaller than either the Hudson Bay series or those from the Alaska coast.

The disposition of the name *kennicottii*, proposed by Ross in 1861 is made difficult by the lack of comparable material from the type locality, which, as shown by Preble (1908, p. 162), is "the lower Mackenzie region", in the vicinity of Old Fort Good Hope and Anderson River. Unfortunately, there are available only three summer specimens from this section, one from Old Fort Good Hope, taken June 27, one from Lockhart River, without date, and one from Anderson River, August 1. The Anderson River specimen is an immature individual in a much worn pelage, but is clearly referable to *parryii*, the under parts being of the same tawny color; the Lockhart River specimen is in a worn (summer?) pelage, with very indistinct spotting; the under parts and sides are ochraceous buff, considerably paler than in typical *parryii*; the Fort Good Hope specimen was apparently acquiring summer pelage; it is paler on the head, tail, sides, and under parts than typical *parryii*; the upper parts are of a uniform brownish gray tone, practically without spotting; possibly this individual, which in size and cranial characters agrees with *parryii*, represents approach to the subspecies *plesius*, which occupies the mountainous regions west of the Mackenzie Valley; the same may be said of two specimens from Fort McPherson, which are slightly paler than *parryii* and have smaller skulls.

Preble (1908, p. 162) has set up "*kennicottii*" as a subspecies of *parryii*, considering it to be identical with *C. p. barrowensis*, but the recent acquisition of a large series of the latter form from Point

Hope, Alaska, shows it to be decidedly paler than typical *parryii* and paler even than the specimens representing "*kennicottii*." In consideration also of the occurrence of practically typical *parryii* in the mountains along the Alaska-Yukon boundary, lying to the westward of the Mackenzie Valley, it seems probable that when a larger series from the type region of "*kennicottii*" is made available, they will be shown to be referable to *parryii*.

The almost complete absence of specimens in summer pelage from the Arctic coast of Mackenzie and Alaska makes it difficult to determine with certainty the western limits of the present form on that coast. However, since the series in summer pelage from Firth River, Yukon, some 45 miles back from the coast, is clearly referable to *parryii*, it seems reasonable to consider that the specimens in winter pelage from the northeast coast of Alaska, as far west as Collinson Point, are of the same race. No specimens are available between Collinson Point and Point Barrow.

*Specimens examined*.—Total number, 205, as follows:

- Alaska: Collinson Point, 11;<sup>62</sup> Hula Hula River, 8;<sup>62</sup> International Boundary, 80 miles north of Porcupine River, 1; Okpilak River (west of Barter Island), 4;<sup>63</sup> Porcupine River (12 miles below Coleen River and near Salmon Trout River), 4; Sadlerochit River, 2.<sup>62</sup>
- Northwest Territories [Mackenzie]: Anderson River, 2; Artillery Lake, 16 (3 skins with skulls, 13 skulls only);<sup>64</sup> Aylmer Lake, 9<sup>63</sup> (skulls); Bernard Harbor (Dolphin and Union Strait), 25;<sup>62</sup> Clinton Colden Lake, 10; Coppermine River (mouth), 3;<sup>62</sup> Cape Eskimo, 3;<sup>62</sup> Cape Fullerton, 9;<sup>63</sup> Coronation Gulf, 6;<sup>62</sup> Deas Thompson Point, 1;<sup>62</sup> Dease Bay, Great Bear Lake, 2;<sup>62</sup> Fort Anderson, 7 (1 skin, 6 skulls only); Fort Good Hope, 2; Fort McPherson, 2; Hanbury and Thelon Rivers (junction), 5;<sup>63</sup> Hudson Bay (25 miles south of Cape Eskimo), 4; Kasba Lake, 2; Langton Bay (arm of Franklin Bay), 3;<sup>63</sup> Lockhart River, 2; "Mackenzie" (no labels), 7;<sup>63</sup> Mackenzie River Delta, 3;<sup>62</sup> Marble Island, 1; Old Fort Good Hope, 4.
- Yukon: Firth River (on 141st. meridian), 15; Joe River (Firth River), 17; Old Crow River (mouth, and 50 miles above Timber Creek), 11; Rampart House, 2; U Creek (90 miles north of Rampart House), 2.

#### CITELLUS PARRYII BARROWENSIS (MERRIAM)

##### BARROW GROUND SQUIRREL

*Spermophilus barrowensis* Merriam, Wash. Acad. Sci. Proc. 2: 19, Mar. 14, 1900.  
*Spermophilus beringensis* Merriam, Wash. Acad. Sci. Proc. 2: 20, 1900 (Cape Lisburne, Alaska).

*Type*.—Collected at Point Barrow, Alaska, May 30, 1883, by Lt. P. H. Ray; male adult, skin and skull; no.  $\frac{14061}{37824}$ , U. S. Natl. Mus. (orig. no. 1428).

*Range*.—Arctic coast of Alaska from Point Hope eastward at least to Point Barrow; limits of range not known (fig. 8). *Zonal range*: Arctic.

*External characters*.—Similar to *C. p. parryii*, but coloration paler, both above and below; top and sides of head, sides of neck, and thighs paler (less reddish); similar in color to *C. p. abbusus*, but upper parts averaging paler (less brownish); sides of body more tawny (less grayish), and under parts slightly darker.

<sup>62</sup> Natl. Mus. Canada.

<sup>63</sup> Amer. Mus. Nat. Hist.

<sup>64</sup> Twelve in Amer. Mus. Nat. Hist.

*Cranial characters.*—Skull essentially like that of *parryii*.

*Color.*—*Summer pelage* (August): Top of head (nose to occiput) tawny or russet; sides of face cinnamon buff; sides of neck ochraceous tawny; upper parts sayal brown or mikado brown, abundantly and coarsely flecked with whitish or warm buff spots; nape and fore-back washed with grayish white; legs cinnamon; feet cinnamon buff; tail tawny or mikado brown, more or less mixed above with black, tip wholly black; under parts cinnamon or cinnamon buff. *Winter pelage* (October–May): Coloration of upper parts and sides more grayish than in summer; sides of nose pinkish buff; feet paler than in summer, sometimes pinkish buff; under parts cinnamon buff or pinkish buff.

*Molt.*—The spring molt is not shown by any of the specimens examined, but probably it occurs in June, as in the other races.

*Measurements.*—Average of 11 adult males from Point Hope, Alaska: Total length, 411.6 (383–440); tail vertebrae, 118.6 (107–142); hind foot, 65 (61–68); ear from notch (dry), 7.6 (6–9). Average of 10 adult females from Point Hope: Total length, 390.2 (368–420); tail vertebrae, 113.2 (101–127); hind foot, 61 (59–65); ear from notch (dry), 6.7 (6–7). *Skull:* Average of 12 adult males (Point Barrow, 7; Point Hope, 5): Greatest length, 60.9 (58–62.9); palatilar length, 32 (30.8–33); zygomatic breadth, 40.4 (38.1–42.2); cranial breadth, 24.4 (24.2–25.1); interorbital breadth, 13 (12.1–13.5); postorbital constriction, 13.9 (13–15.5); length of nasals, 23 (21.3–25.4); maxillary tooth row, 13.9 (13.2–15). Average of 6 adult females (Point Barrow, 2; Point Hope, 4): Greatest length, 59.1 (57.8–60.8); palatilar length, 30.9 (30–31.8); zygomatic breadth, 39.7 (37.9–41.2); cranial breadth, 23.2 (22.4–24.1); interorbital breadth, 12.9 (12.2–14.6); postorbital constriction, 12.7 (12–14.4); length of nasals, 21.9 (20.9–23.1); maxillary tooth row, 13.4 (13–13.9).

*Remarks.*—The ground squirrels inhabiting the northwest coast of Alaska are distinctly paler than typical *parryii* from Hudson Bay. The series of eight summer skins from Point Barrow agrees essentially with a large series from Point Hope, recently collected by R. M. Gilmore for the Museum of Vertebrate Zoology; hence the name *C. p. beringensis*, based originally on two skins without skulls from Cape Lisburne, is placed in the synonymy of *C. p. barrowensis*, the latter name having page priority. The subspecies ranges eastward on the coast at least to Point Barrow and possibly farther, but no specimens have been seen from points between Point Barrow and Collinson Point. The majority of the specimens available from the Arctic coast of northeastern Alaska and Mackenzie are in winter pelage, in which pelage the characters are less pronounced; a good series in summer pelage is needed to determine with certainty the limits of range of the two races, *parryii* and *barrowensis*.

*Specimens examined.*—Total number, 69, as follows:

Alaska: Cape Lisburne, 4 (2 skins, 2 separate skulls); Cape Thompson, 1;<sup>65</sup> Point Barrow, 31 (15 skins; 16 extra skulls); Point Hope, 30<sup>66</sup>; Wainwright, 2<sup>67</sup>; Wainwright Inlet, 1.

<sup>65</sup> Mus. Vert. Zool.

<sup>66</sup> Twenty-eight in Mus. Vert. Zool.

<sup>67</sup> Colorado Mus. Nat. Hist.

## CITELLUS PARRYII PLESIUS (OSGOOD)

## YUKON GROUND SQUIRREL

(Pls. 24, D; 29, D)

*Spermophilus empetra plesius* Osgood, North Amer. Fauna 19: 29, Oct. 6, 1900.

[*Citellus*] *plesius* Osgood, Biol. Soc. Wash. Proc. 16: 25, 1903.

*Citellus erythrogluteus* Allen, Amer. Mus. Nat. Hist. Bull. 19: 534, 1903 (not *Arctomys parryi* var.  $\beta$  *erythroglutea* Richardson).

*Type*.—Collected at Bennett City, head of Lake Bennett, British Columbia, June 19, 1899, by W. H. Osgood; female adult, skin and skull, no. 98931, U. S. Natl. Mus. (Biological Survey collection) (orig. no. 465).

*Range*.—Northwestern British Columbia, greater part of Yukon (except extreme northern part) and mountainous parts of Mackenzie (west of the Mackenzie River); north to the Ogilvie Range (head of Coal Creek), Yukon; east to Fort Liard and the Nahanni Hills, Mackenzie; south to vicinity of Tatletuey Lake, British Columbia; west to Glacier, British Columbia, and Delta River (Ober Creek), Alaska (fig. 8). *Zonal range*: Hudsonian.

*External characters*.—Similar to *C. p. parryii*, but decidedly smaller; coloration much paler and more grayish (less tawny) above; sides, under parts, and feet paler; dorsal spots smaller.

*Cranial characters*.—Skull similar to that of *parryii*, but much smaller; rostrum and nasals shorter; zygomata less widely expanded; frontal shield less elevated; temporal ridges less distinctly lyrate than in *C. p. lyratus* and *C. kodiacensis*, but not united posteriorly in a prominent crest as in *C. p. ablusus*. Teeth similar; posterior loph on  $m^3$  usually continuous and well developed.

*Color*.—*Summer pelage*: Head and front of face tawny or sayal brown; sides of nose clay color or cinnamon buff; sides of head and neck ochraceous tawny or cinnamon buff, mixed with fuscous; general tone of upper parts buffy gray, caused by a mixture of fuscous, pinkish buff, and grayish white (the hairs being fuscous subterminally and tipped with whitish or pinkish buff); back moderately sprinkled with grayish white, squarish spots (sometimes indistinct or nearly obsolete); sides and under parts ochraceous tawny or cinnamon buff; feet cinnamon, cinnamon buff, or clay color; tail above mixed cinnamon and fuscous, becoming fuscous black on distal half, and edged with pinkish buff; tail beneath, tawny or pale russet, the tip fuscous black. *Winter pelage* (Sept. 19): Upper parts and sides pale smoke gray shaded with fuscous and washed in middle of back with cinnamon buff; under parts grayish white, thinly washed with pinkish buff; otherwise as in summer.

*Molt*.—The spring molt takes place in late June; two specimens from Bennett, British Columbia, June 18 and 22, are in badly worn winter pelage, with new pelage covering the head, nape, and most of the under parts. Specimens showing the fall molt are not available, but one from Bennett taken September 19 is apparently in full winter pelage.

*Measurements*.—Average of 10 adult males from type locality: Total length, 339.2 (320–363); tail vertebrae, 95.5 (85–105); hind foot, 54 (50–57). Average of 8 adult females from Bennett, British Columbia, and head of Coal Creek, Yukon: Total length, 329 (300–352); tail vertebrae, 90.4 (85–102); hind foot, 52.9 (52–54). *Skull*: Average of 10 adult males from type locality: Greatest

length, 53.5 (51.5-56.4); palatilar length, 26.2 (25-28); zygomatic breadth, 34.6 (33.5-35.5); cranial breadth, 22.5 (21.4-23.3); interorbital breadth, 11.2 (10.2-12.2); postorbital constriction, 13.2 (12.6-13.7); length of nasals, 19 (17.7-20.7); maxillary tooth row, 12 (11.4-12.4). Average of 10 adult females from type locality: Greatest length, 52 (50.7-53.3); palatilar length, 25.5 (25-26); zygomatic breadth, 33.5 (32.2-34.9); cranial breadth, 21.6 (21.1-22.1); interorbital breadth, 10.5 (10-11.4); postorbital constriction, 12.6 (11.9-13.1); length of nasals, 18.7 (18.1-19.8); maxillary tooth row, 11.7 (11.1-12.3).

*Weight*.—An adult female (Chitina River, Alaska) weighed slightly over one pound (no embryos).

*Remarks*.—The Yukon ground squirrel is distinguishable from *parryii* and *C. osgoodi* by its smaller size and paler coloration. It occupies the greater part of the Province of Yukon (except the portion north of the Porcupine River) as well as parts of Mackenzie and British Columbia, and ranges westward into Alaska, where it merges into the subspecies *ablusus*. Southward it does not reach the range of *C. columbianus*.

Specimens from the headwaters of Telegraph Creek and Sheslay River, northern British Columbia, were assigned by J. A. Allen (1903a, p. 534) to *Citellus erythrogluteus* (Richardson) on the assumption that its type locality—"head of Elk River, Rocky Mountains"—is in latitude 57°, as indicated by Richardson. As shown, however, on page 88, the Elk River of Richardson is the Athabaska, whereas the type locality of *erythrogluteia* is actually near the headwaters of Sulphur River, Alberta.

*Specimens examined*.—Total number, 158, as follows:

- Alaska: Chitina River Glacier, 4;<sup>68</sup> Ober Creek (Jarvis Creek, Delta River region), 2; Tanana Crossing, 1; Tanana Hills, 2; White Pass, 5.  
 British Columbia: Bennett, 38; Chapa-atan River (Stikine River, near head), 3; Cassiar Mountains (near Dease Lake), 2; Ispatseezh River (Stikine River, near head), 3; Klappan River Valley (near head), 1; Little Klappan River (headwaters), 1; McDame Creek (Dease River), 3; McKee Creek, Atlin District, 1;<sup>69</sup> Rapid River (Dease River), 1; Sheep Mountain (Dease River), 2; Sheslay River (timber line, 4,000 feet altitude), 1; Tatletuey Lake, 1; Telegraph Creek (near head), 6; Wilson Creek, Atlin District, 5.<sup>69</sup>  
 Northwest Territories [Mackenzie]: Fort Liard, 1;<sup>70</sup> Fort Norman (mountains west), 1; Fort Simpson [probably from Nahanni Hills], 1;<sup>70</sup> Mackenzie Mountains, 2.<sup>72</sup>  
 Yukon: Coal Creek (near head), 18; Donjek River, 2; Livingston, 1;<sup>71</sup> Pelly Lake, 1; Pelly River (Lapie River), 6; Tantalus, 1;<sup>68</sup> Teslin Lake (and vicinity), 25;<sup>68</sup> Yukon River, 17 (Caribou Crossing, 6; Fifty-mile River, 1; Lake Lebarge, 2; Lake Marsh, 6; Miles Canyon, 1; Rink Rapids, 1).

#### CITELLUS PARRYII ABLUSUS Osgood

##### ALEUTIAN GROUND SQUIRREL

*Citellus plesius ablusus* Osgood, Biol. Soc. Wash. Proc. 16: 25, Mar. 19, 1903.

*Citellus stonei* Allen, Amer. Mus. Nat. Hist. Bull. 19: 537, 1903 (Stevana Flats, near Port Moller, Alaska Peninsula (not Wrangell), Alaska). (Allen, op. cit. p. XVII).

*Type*.—Collected at Nushagak, Alaska, September 16, 1902, by W. H. Osgood and A. G. Maddren; male adult, skin and skull, no. 119815, U. S. Natl. Mus. (Biological Survey collection) (orig. no. 2043).

<sup>68</sup> Natl. Mus. Canada.

<sup>69</sup> Provincial Mus., Victoria, B. C.

<sup>70</sup> Univ. of Michigan Mus. Zool.

<sup>71</sup> Field Mus. Nat. Hist.

<sup>72</sup> Amer. Mus. Nat. Hist.

*Range*.—Alaska, mainly south of the Yukon Valley; north on the coast to Eschscholtz Bay; west on the Alaska Peninsula to its tip; south to base of the Kenai Peninsula; east to headwaters of Tanana River; introduced on Unalaska, Umnak, and Kavalga Islands (fig. 8). *Zonal range*: Hudsonian and Arctic.

*External characters*.—Similar in color to *C. p. plesius* but upper parts (in summer) more brownish (less grayish); dorsal spotting less distinct and spots smaller; under parts averaging paler; tail usually more blackish, the under surface a slightly darker shade of russet; skull larger and relatively narrower. Compared with *C. p. parryii*: Size much smaller; dorsal spots smaller; coloration paler, especially on the under parts, sides of neck, legs, and under surface of tail. Compared with *C. p. barrowensis*: Size smaller; coloration of upper parts darker (more brownish); sides paler (less tawny); under parts averaging paler.

*Cranial characters*.—Skull larger than that of *plesius*, with relatively narrower brain case; rostrum and nasals longer; audital bullae larger—both longer and broader—but rather flat; temporal ridges less distinctly lyrate in shape than in *C. p. lyratus* and *C. kodiacensis*, uniting posteriorly to form a slight crest; skull decidedly smaller than that of *barrowensis* or *parryii*.

*Color*.—*Summer pelage*: Top of head and face russet or tawny; sides of head pinkish buff or cinnamon buff, shaded with fuscous; front legs and sides of neck tawny; upper parts walnut brown, washed on neck and shoulders with pale buff, and abundantly flecked with irregular, buffy white spots; fore and hind feet clay color; tail above, mixed cinnamon buff and fuscous black, becoming solid blackish on distal fourth; tail beneath, russet or tawny; under parts clay color or cinnamon buff. *Worn winter pelage*: General tone of upper parts snuff brown, washed on neck and shoulders with pale smoke gray; sides of head and neck smoke gray; sides of body pale buff mixed with white; under parts grayish white, faintly washed with pinkish buff; otherwise as in summer.

*Molt*.—The beginning of the spring molt is shown by an adult male specimen taken June 16 at Lake Aleknagik, Alaska; new hair is appearing on the head, shoulders, and fore legs, the rest of the body being in worn winter pelage.

*Measurements*.—Average of 8 adult males from Nushagak and Swan Lake, Alaska: Total length, 374.5 (359–394); tail vertebrae, 102.8 (95–108); hind foot, 58.5 (55–61). Average of 6 adult females from same localities: Total length, 346.3 (340–356); tail vertebrae, 99.5 (95–108); hind foot, 56.2 (55–59). *Skull*: Average of 7 adult males from Nushagak, Alaska: Greatest length, 57 (55.7–58.8); palatilar length, 28.4 (27–29.5); zygomatic breadth, 36.7 (35.4–38.5); cranial breadth, 23 (22.6–23.7); interorbital breadth, 12.6 (11.6–14); postorbital constriction, 13.3 (12.3–14); length of nasals, 21.1 (19.8–22.6); maxillary tooth row, 12.3 (11.8–12.9). Average of 7 adult females from Nushagak: Greatest length, 55.3 (54.2–57.1); palatilar length, 27.7 (27–29); zygomatic breadth, 35 (33.8–36.4); cranial breadth, 22.2 (21.5–22.5); interorbital breadth, 12.1 (11.5–13); postorbital constriction, 13 (12–14); length of nasals, 12 (11.4–12.4).

*Remarks*.—The Aleutian ground squirrel is closely related to *plesius*, with which it intergrades in eastern Alaska. Material is lacking to show the exact limits of its range eastward. Certain specimens from Nome, on the Seward Peninsula, show approach to *barrowensis* in their larger skulls; intergradation with that race doubtless occurs between Eschscholtz Bay and Point Hope.

Comparison of the type of *C. "stonei"* and a good series from the type region with typical *ablusus* shows no characters to separate the two forms. Hence "*stonei*" (supposed at the time it was described to have come from Wrangell, Alaska) falls in the synonymy of *C. p. ablusus*, which has several months' priority.

In the summer of 1913, 18 ground squirrels of this subspecies were captured at Nushagak and shipped to St. George Island in a single large crate.

Although plentifully supplied with green food, they preyed on each other, and while this tendency was overcome to some extent by supplying them with meat, the stock of 18 had been reduced to 5 before they reached their destination. These five, an adult and four young, including both sexes, were liberated on St. George; at least two survived until May 1914, but by the summer of that year all apparently had disappeared (Osgood, Preble, and Parker, 1915, p. 129).

This subspecies is closely similar to *C. buxtoni* (Allen, 1903c, p. 139) of eastern Siberia, differing chiefly in less intensely tawny coloration, and more blackish tail; in these characters *buxtoni* closely resembles *C. p. parryii*, which, however, is decidedly larger; since *buxtoni* intergrades in characters with *ablusus*, it may well be given subspecific status under the name *Citellus parryii buxtoni*.

*Specimens examined*.—Total number, 274, as follows:

Alaska: Alaska Peninsula, 110 (Chignik, 24; Cold Bay, 10; Frosty Peak, 17; Herenden Bay, 7; <sup>73</sup> Izembek Bay, 1; Katmai, 2; Kings Cove, 5; Kukak Bay, 5; Moller Bay, 8; <sup>73</sup> Morzhovoi Bay, 8; Pavlof Mountain, 2; Portage Bay, 20; Stepovak Bay, 1); Anchorage, 1; <sup>73</sup> Bristol Bay, 1; Cape Prince of Wales, 4; Eschscholtz Bay, 4; Golofnin Bay, 1; Jennie Creek, Mount McKinley Park, 1; Kakhtul River, 4; Kanulik, 3; Kavalga Island, 2; Kokwok River, 1; Lake Aleknagik, 20; Lake Clark, 4; Mount McKinley, 19; Nome, 7; <sup>74</sup> <sup>75</sup> Nushagak, 14; Savage River, Mount McKinley Park, 3; Pavlof Mountain, 1; <sup>76</sup> Swan Lake (Mulchatna-Chulitna Portage), 4; Teller, 1; <sup>76</sup> Togiak, 1; Unalaska Island, 55; Unimak Island, 11; Ushagat Island, 2.

#### CITELLUS PARRYII NEBULICOLA Osgood

##### SHUMAGIN GROUND SQUIREL

*Citellus nebulicola* Osgood, Biol. Soc. Wash. Proc. 16: 26, Mar. 19, 1903.

*Type*.—Collected on Nagai Island, Shumagin Islands, Alaska, June 24, 1893, by C. H. Townsend; female adult, skin and skull, no. 59145, U. S. Natl. Mus.

*Range*.—The Shumagin Islands (Nagai, Simeonoff, and Koniuji), Alaska (fig. 8). *Zonal range*: Hudsonian.

*External characters*.—Very similar in color to *C. p. ablusus*, but smaller, with shorter tail and hind feet. Compared with *C. kodiacensis*: Size smaller; coloration of upper parts more brownish or ochraceous (less grayish); under parts darker; tail in summer pelage more tawny (less blackish).

*Cranial characters*.—Skull similar to that of *kodiacensis* and *ablusus* but averaging smaller, with relatively longer tooth row; closely similar to that of *C. p. plesius*, but nasals slightly longer, narrower at posterior end, and elevated along the median suture. In two of the skulls examined the posterior loph on *m*<sup>3</sup> is discontinuous, in this character showing approach to *kodiacensis*.

<sup>73</sup> Amer. Mus. Nat. Hist.

<sup>74</sup> Mus. Comp. Zool.

<sup>75</sup> Colorado Mus. Nat. Hist.

<sup>76</sup> Carnegie Mus.

*Color.*—*Summer pelage:* Top of head and face russet or tawny; eye ring pinkish buff or buffy white; sides of nose pinkish buff, sides of face cinnamon buff, shaded with fuscous; sides of neck, and front legs, ochraceous tawny; upper parts snuff brown or verona brown, sprinkled with cinnamon and abundantly flecked with creamy white spots; feet cinnamon buff or clay color, the toes pinkish buff; tail above, fuscous black, mixed with cinnamon or cinnamon buff and edged with pinkish buff; tail beneath, russet or mikado brown, tipped with fuscous black; under parts clay color, shading to pinkish buff on throat. *Winter pelage:* Upper parts similar to the summer pelage but much more whitish, the snuff brown hairs more extensively tipped with white, and the shoulders and sides pale smoke gray; tail above, fuscous black, faintly shaded with sayal brown and edged with buffy white; tail beneath, snuff brown or cinnamon brown, tipped with black; feet pale pinkish buff; under parts white, faintly shaded with pale pinkish buff.

*Molt.*—A specimen taken May 16 is in worn winter pelage, showing new summer fur appearing in scattered patches on the head and back.

*Measurements.*—Average of 3 adult males (measured dry): Tail vertebrae, 79.7 (77–82); in 8 adults (4 males, 4 females) the hind foot (dry) averages 52.1 (50–55.7). *Skull:* Average of 4 adult females: Greatest length, 52.6 (50.7–55.4); palatilar length, 26.2 (25.5–27); zygomatic breadth, 33.7 (32–35); cranial breadth, 21.7 (21.1–22.2); interorbital breadth, 11.4 (11.1–11.8); postorbital constriction, 12 (11–13.2); length of nasals, 19.4 (18.2–20); maxillary tooth row, 11.5 (11.3–11.7).

*Remarks.*—This depauperate insular race shows relationship both to *ablusus* of the mainland and to *kodiacensis* of Kodiak Island. The material at hand is too limited to show clearly its exact relationship to the other forms of the species, but since its characters overlap those of *ablusus* it is assigned a subspecific relationship with that race.

*Specimens examined.*—Total number, 15, as follows:

Alaska: Shumagin Islands, 15 (Nagai Island, 10; Koniuji Island, 1; Simeonof Island, 4).

#### CITELLUS PARRYII LYRATUS HALL AND GILMORE

##### ST. LAWRENCE ISLAND GROUND SQUIRREL

(Pls. 24, B; 29, B)

*Citellus lyratus* Hall and Gilmore, Calif. Univ. Pubs., Zool. 38: 396, Sept. 17, 1932.

*Type.*—Collected at Iviktook Lagoon (about 35 miles northwest of Northeast Cape),<sup>77</sup> St. Lawrence Island, Bering Sea, Alaska, July 7, 1931, by Raymond M. Gilmore; male adult, skin and skull, no. 51172, Mus. Vert. Zool. (orig. no. 1738).

*Range.*—St. Lawrence Island, Bering Sea, Alaska (fig. 8).  
*Zonal range:* Arctic.

*External characters.*—Similar to *C. p. ablusus*, of the Alaska Peninsula, but upper parts paler and more grayish (less brownish); under parts, sides of neck, legs, and feet paler buff; tail longer and more grayish (less tawny) above and paler beneath. Compared

<sup>77</sup> Location as defined by R. M. Gilmore, August 1933.

with *C. p. nebulicola*: Size larger; colors paler throughout; tail above mainly blackish or grayish rather than tawny.

*Cranial characters*.—Skull similar in size and proportions to that of *ablusus*, differing from it in the absence of a prominent sagittal crest, the temporal ridges being lyrate in shape, meeting at the posterior end only in old age to form a very slight crest; nasals relatively broader at posterior end; posterior loph on *m*<sup>3</sup> well developed and continuous (as in *C. buxtoni* and *ablusus*).

*Color*.—*Summer pelage* (July): Top of head mikado brown; sides of face pinkish buff; front legs and sides of neck cinnamon buff; general tone of upper parts light brown, heavily spotted with white, the individual hairs plumbeous at base, then light pinkish buff, then pale fuscous, and tipped with white; thighs cinnamon buff; hind feet pinkish buff; under parts cinnamon buff, the throat clay color; tail above (much worn), grayish white, shaded with dull buffy, the tip fuscous or fuscous black; tail beneath, dull, pale russet, edged with grayish white and tipped with fuscous black. *Worn winter pelage* (June 23 and 25): Upper parts chiefly drab or wood brown; sides grayish white; feet pale pinkish buff; under parts white or dull cinnamon buff.

*Molt*.—The molt apparently takes place in June or early in July; specimens taken June 23 and 25 are in badly worn winter pelage, with new hair showing in patches on the head, back, and under parts.

*Measurements*.—Average of 4 adults (3 males, 1 female) from type locality: Total length, 370 (350–381); tail vertebrae, 107 (97–114); hind foot, 57.2 (54–60). *Skull*: Average of 7 adult males: Greatest length, 57.4 (56.2–58.7); palatilar length, 28.7 (28–29.5); zygomatic breadth, 36.6 (35.8–37.3); cranial breadth, 22.9 (22.2–23.3); interorbital breadth, 12.8 (12.1–13.9); postorbital constriction, 13.8 (13.2–14.1); length of nasals, 21.2 (20.5–21.7); maxillary tooth row, 12 (11.8–12.4). Average of 4 adult females: Greatest length, 54.3 (53–56.6); palatilar length, 27.4 (27–28); zygomatic breadth, 34.2 (33.4–34.9); cranial breadth, 22 (21.5–22.6); interorbital breadth, 11.8 (11.6–12.2); postorbital constriction, 13.4 (13–13.9); length of nasals, 19.8 (19.2–20.4); maxillary tooth row, 11.9 (11.5–12.3).

*Remarks*.—The St. Lawrence Island ground squirrel seems to be most nearly related to the form occurring at Emma Harbor, Siberia,<sup>78</sup> which in turn is very close to *ablusus* of the Alaska Peninsula, but differs from it in slightly paler coloration and in having a longer tail. In skull characters, also, *lyratus* agrees with the Asiatic species in the lyrate shape of the temporal ridges and in tooth characters. *C. buxtoni*, from Gichiga, Siberia, is decidedly richer (more tawny) in color than either *lyratus* or *ablusus*, and has the upper surface of the tail more ochraceous, less suffused with black.

The present form is much more grayish (less tawny) than either *ablusus* or *buxtoni*. It is decidedly smaller, as well as paler colored, than *parryi* of the Arctic coast of Alaska. It differs from *C. kodiakensis* in paler colors of the dorsal surface, feet, and tail, coarser spotting, and in the crown pattern of the last upper molar.

*Specimens examined*.—Total number, 41,<sup>79</sup> from St. Lawrence Island.

<sup>78</sup> The ground squirrels of the Chukchi Peninsula (Emma Harbor, Plover Bay, and Koliuchin Bay) may prove to be referable to *C. stegnegeri* of Kamchatka, but the single specimen (the type) of *stegnegeri* now available is too young and too much worn to permit of satisfactory comparison.

<sup>79</sup> 15 in Mus. Vert. Zool.

## CITELLUS KODIACENSIS (ALLEN)

## KODIAK GROUND SQUIRREL

*Spermophilus parryi* var. *kodiacensis* Allen, Boston Soc. Nat. Hist. Proc. 16: 292, 1874.

[*Spermophilus empetra*] var. *kodiacensis* Allen, Monog. North Amer. Rodentia, p. 839, 1877.

[*Citellus parryi*] *kodiacensis* Tronessart, Cat. Mamm., Sup., p. 338, 1904.

*Lectotype*<sup>80</sup>.—Collected on Kodiak Island, Alaska, June 1868, by Ferdinand Bischoff; female adult, skin and skull, no.  $\frac{9242}{38543}$ , U. S. Natl. Mus.

*Range*.—Kodiak Island (fig. 8). *Zonal range*: Hudsonian.

*External characters*.—Similar to *C. parryii ablusus* but dorsal spots smaller and more abundant (though sometimes nearly obsolete); general tone of upper parts in summer pelage more grayish (less suffused with ochraceous).

*Cranial characters*.—Skull similar to that of *ablusus* but molar teeth averaging slightly smaller;  $m^3$  with posterior loph poorly developed and often not continuous, but broken by a median sulcus; temporal ridges lyrate in shape (as in *C. p. lyratus*) not uniting posteriorly in old age to form a prominent crest.

*Color*.—*Summer pelage*: Head and front of face tawny or pale russet (this color reaching back only to front border of ears); sides of nose pinkish buff; sides of face and neck cinnamon buff mixed with fuscous, shading to ochraceous tawny on throat and base of fore legs; upper parts from crown to root of tail mixed fuscous and cinnamon buff (the general tone near snuff brown), extensively tipped with buffy white, usually appearing as small irregular spots; shoulders washed with cinnamon buff; sides of body like back but more grayish (less brownish); feet clay color or pinkish buff; tail above chiefly fuscous black, mixed with tilleul buff and bordered with the same; shaded near base with sayal brown; tail beneath, sayal brown or mikado brown, much mixed with buff, the tip fuscous black; under parts cinnamon buff or pinkish buff. *Winter pelage*: (April and May specimens): Similar to the summer pelage but tips of hairs on upper parts more whitish, especially on shoulders; sides of head, neck, and body mainly grayish white, with little buff; feet pinkish buff or buffy white; under parts grayish white, faintly washed with pinkish buff.

*Measurements*.—Average of 10 adult males from Kodiak Island: Total length, 358.2 (332–400); tail vertebrae, 96.5 (81–112); hind foot, 56.4 (52–60). Average of 10 adult females from same locality: Total length, 353.2 (333–375); tail vertebrae, 96.4 (77–104); hind foot, 54.7 (51–58). *Skull*: Average of 10 adult males from Kodiak Island: Greatest length, 56.2 (55–57.8); palatilar length, 28 (27–29); zygomatic breadth, 36.8 (35.7–37.6); cranial breadth, 23.3 (22.9–24); interorbital breadth, 12.3 (11.8–13.6); postorbital constriction, 12.5 (11.4–14.2); length of nasals, 21 (19.6–21.9); maxillary tooth row, 11.7 (11.2–12.7). Average of 10 adult females from same locality: Greatest length, 54.4 (51.8–55.7); palatilar length, 27.2 (25.5–28); zygomatic breadth, 35.5 (34.5–36.8); cranial breadth, 22.6 (21.7–23.2); interorbital breadth, 12 (11.5–12.5); postorbital constriction, 12.5 (11.5–13.7); length of nasals, 20.5 (18.5–21.3); maxillary tooth row, 11.4 (10.3–12).

<sup>80</sup> No type was designated; this specimen is the only one of those listed by Allen in his monograph (1877, p. 848), now remaining in the National Museum collection. It is hereby designated as a lectotype.

*Remarks.*—The Kodiak ground squirrel is closely related to *ablusus*, inhabiting the nearby mainland, but since it differs in both cranial and color characters it is considered a distinct species. Osgood states (1903, p. 27), on the authority of a native, that the spermophiles on Kodiak Island were introduced from North Semidi Island; no specimens from the latter island have been seen, but the rather pronounced characters of *kodiakensis* indicate that the species probably has occupied Kodiak Island for a long period.

*Specimens examined.*—Total number, 45, from Kodiak Island.

CITELLUS OSGOODI (MERRIAM)

YUKON VALLEY GROUND SQUIRREL

(Pls. 24, C; 29, C)

*Spermophilus osgoodi* Merriam, Wash. Acad. Sci. Proc. 2: 18, Mar. 14, 1900.  
[*Citellus*] *osgoodi* Osgood, Biol. Soc. Wash. Proc. 16: 27, 1903.

*Type.*—Collected at Fort Yukon, Alaska, April 29, 1877, by L. M. Turner; male adult, skin and skull; no.  $\frac{12789}{37822}$ , U. S. Natl. Mus. (orig. no. 1635).

*Range.*—The Yukon Valley, from a point about 25 miles above Circle to the Yukon Flats, west of Fort Yukon and possibly to the mouth of the Tanana (Osgood, 1900, p. 31) (fig. 8). *Zonal range:* Hudsonian.

*External characters.*—Similar to *C. parryii parryii* but tail longer; coloration darker (more reddish) and dorsal spots smaller; feet darker.

*Cranial characters.*—Skull closely similar to that of *parryii*; auditory bullae averaging slightly smaller and less inflated.

*Color.*—*Summer pelage* (July): Entire top of head (nose to occiput) chestnut or bay; sides of nose tawny or ochraceous tawny; sides of head, neck, and shoulders hazel or chestnut, sometimes washed with ochraceous buff and streaked with blackish; ears ochraceous tawny on both surfaces; dorsum mars brown, more or less overlaid with pinkish buff, and thickly flecked with spots of buffy white; anterior sides hazel; posterior sides like back but more washed with buffy; legs and feet hazel; under parts hazel or amber brown; tail above, black, more or less overlaid and edged with cinnamon buff or tilleul buff; tail beneath, mikado brown, shaded with cinnamon buff and broadly tipped with black. *Winter pelage* (October–April): Head as in summer; sides of nose and cheeks cinnamon buff or ochraceous buff; nape washed with cinnamon buff or tawny; shoulders and fore back extensively overlaid with pale smoke gray and sides heavily washed with same; legs and feet tawny; under parts tawny or ochraceous tawny, sometimes irregularly shaded with cinnamon buff and buffy white; tail hazel beneath. *Melanistic phase:* About 20 percent of the specimens examined are in this phase; most of them are solid blackish brown, more or less sprinkled with buffy grayish hairs and with patches of bay on the nose; several are pure black on the entire body, with a few brownish hairs at the tip of the tail; one young specimen is sprinkled with grayish and buffy spots on a blackish ground, the nose and feet washed with brownish.

*Molt.*—The spring molt begins in late June; specimens taken near Circle June 27–30 show new pelage covering most of the under parts

and appearing on the head, shoulders, and front legs; others taken the same dates are in complete summer pelage. A specimen from Fort Yukon taken October 15, 1885, was apparently acquiring winter pelage, but the method of molting is not clearly shown.

*Measurements.*—Average of 10 adult males from near Circle, Alaska: Total length, 456.4 (437–475); tail vertebrae, 141.7 (131–153); hind foot, 62.7 (61–65). Average of 10 adult females from same locality: 433 (420–462); 136 (126–147); 60.3 (57–63). *Skull:* Average of 10 adult males from Circle, Alaska: Greatest length, 63.1 (60.2–65.8); palatilar length, 32.4 (31–34); zygomatic breadth, 41.5 (38.6–44.3); cranial breadth, 24.5 (24–25.5); interorbital breadth, 14 (12.7–15); postorbital constriction, 13.4 (12.5–14.8); length of nasals, 24 (23–25); maxillary tooth row, 14 (13.3–14.6). Average of 10 adult females from same locality: Greatest length, 60.1 (58–61.8); palatilar length, 29.9 (28–31); zygomatic breadth, 39.3 (37.4–42); cranial breadth, 24 (23.3–25.1); interorbital breadth, 13 (12.3–14); postorbital constriction, 13.6 (13–14.4); length of nasals, 22.6 (21.8–23.4); maxillary tooth row, 13.9 (13.4–15).

*Weight* of males,  $1\frac{1}{4}$  to  $2\frac{1}{4}$  pounds (average about  $1\frac{3}{4}$  pounds); of females,  $1\frac{1}{4}$  to  $1\frac{7}{8}$  pounds (average about  $1\frac{1}{2}$  pounds) (Osgood, 1909, p. 23).

*Remarks.*—The Yukon Valley ground squirrel is the largest known member of the *parryii* group; in cranial measurements and size of hind feet it averages about the same as *parryii* but exceeds it in length of tail. It has a very restricted range along the Yukon River and although closely related to *parryii* apparently does not intergrade with it. O. J. Murie, in ascending the Porcupine, saw no squirrels until near the mouth of Coleen River; specimens taken there and at Salmon Trout River and Rampart House are nearly typical *parryii*, showing no approach to *osgoodi*. The lower limit of the species in the Yukon Valley is not definitely known, but the upper limit has been determined by Osgood as a point about 25 miles above Circle. No ground squirrels of any kind occur along the Yukon above that point until near the mouth of Pelly River, where the much smaller form, *C. p. plesius*, finds its lower limit.

Although specimens of this fine squirrel have been in the National Museum collection since 1861, when Kennicott collected a considerable series, they were not recognized as distinct from *parryii* until 1900, when Merriam, after Osgood had recognized it in the field, described the species as new.

*Specimens examined.*—Total number, 62, as follows:

Alaska: Yukon River, 62 (Circle, 1; Fort Yukon, 3; mouth of Porcupine River, 1; <sup>81</sup> 10 miles above Hess Creek, 1; 20 miles above Circle, 55; Yukon Flats, 1).

<sup>81</sup> Mus. Comp. Zool.

## Subgenus ICTIDOMYS Allen

[Characters and synonymy on p. 41]

## KEY TO SPECIES AND SUBSPECIES

- a*<sup>1</sup>. Dorsal area striped.
- b*<sup>1</sup>. Larger; hind foot more than 36 mm.----- *tridecemlineatus* (p. 107)
- b*<sup>2</sup>. Smaller; hind foot less than 36 mm.
- c*<sup>1</sup>. Dark stripes distinctly reddish (russet or mars brown).- *texensis* (p. 110)
- c*<sup>2</sup>. Dark stripes not distinctly reddish.
- d*<sup>1</sup>. Colors paler (dark stripes snuff brown, walnut brown, or cinnamon brown).
- e*<sup>1</sup>. Larger (skull length more than 37 mm)----- *arenicola* (p. 111)
- e*<sup>2</sup>. Smaller (skull length less than 37 mm)----- *parvus* (p. 117)
- d*<sup>2</sup>. Colors darker (dark stripes chestnut brown, mummy brown, or sepia).
- e*<sup>1</sup>. Larger (skull length more than 37.5 mm)----- *pallidus* (p. 112)
- e*<sup>2</sup>. Smaller (skull length less than 37.5 mm).
- f*<sup>1</sup>. Dark stripes mummy brown----- *alleni* (p. 114)
- f*<sup>2</sup>. Dark stripes chestnut brown.
- g*<sup>1</sup>. Under side of tail russet----- *monticola* (p. 116)
- g*<sup>2</sup>. Under side of tail chestnut brown----- *hollisteri* (p. 115)
- a*<sup>2</sup>. Dorsal area spotted.
- b*<sup>1</sup>. Dorsal spots in linear series.
- c*<sup>1</sup>. Larger; skull length more than 45 mm----- *mexicanus* (p. 119)
- c*<sup>2</sup>. Smaller; skull length less than 45 mm----- *parvidens* (p. 121)
- b*<sup>2</sup>. Dorsal spots not in linear series.
- c*<sup>1</sup>. Dorsal spots and under parts buffy----- *perotensis* (p. 132)
- c*<sup>2</sup>. Dorsal spots and under parts white.
- d*<sup>1</sup>. Smaller (skull length less than 36.5 mm).
- e*<sup>1</sup>. Dorsal spots distinct----- *pratensis* (p. 128)
- e*<sup>2</sup>. Dorsal spots not distinct----- *cryptospilotus* (p. 130)
- d*<sup>2</sup>. Larger (skull length more than 36.5 mm).
- e*<sup>1</sup>. Dorsal spots indistinct or obsolete.
- f*<sup>1</sup>. Larger (skull length 39-42.5)----- *major* (p. 126)
- f*<sup>2</sup>. Smaller (skull length 37.7-39.9)----- *obsoletus* (p. 130)
- e*<sup>2</sup>. Dorsal spots distinct.
- f*<sup>1</sup>. Dorsal spots smaller (habitat central Mexico).
- g*<sup>1</sup>. Darker----- *spilosoma* (p. 122)
- g*<sup>2</sup>. Paler----- *pallescens* (p. 124)
- f*<sup>2</sup>. Dorsal spots larger (habitat United States and northern Mexico).
- g*<sup>1</sup>. Smaller (skull length less than 38 mm)----- *cancscens* (p. 125)
- g*<sup>2</sup>. Larger (skull length more than 38 mm).
- h*<sup>1</sup>. Audital bullae larger----- *major* (p. 126)
- h*<sup>2</sup>. Audital bullae smaller----- *annectens* (p. 128)

## CITELLUS TRIDECEMLINEATUS GROUP

## CITELLUS TRIDECEMLINEATUS (MITCHILL)

[Synonymy under subspecies]

*Specific characters*.—Size small to medium; hind foot, 28-41 mm; tail, 60-108; skull length, 34-45.8. Skull relatively long, narrow, and weakly built (in comparison with *C. townsendii mollis* or *C. w. washingtoni*), the brain case usually longer than broad; interorbital region relatively long, the supraorbital margins only slightly elevated; rostrum long and tapering gradually; zygomatica rather stout, but not widely expanded; molariform tooth rows slightly convergent posteriorly; audital bullae moderately inflated, the external meatus tube short.

*Color*.—Upper parts marked with a series of alternating light and dark longitudinal stripes; the dark stripes are usually five in number, brownish or blackish in color and extending down the median

line of each is a series of squarish white or buffy white spots; alternating with the dark stripes are about six narrower whitish stripes; on the sides are several additional, more or less indefinite, stripes and spots; in some races, some of the light dorsal stripes are broken into spots.

CITELLUS TRIDECEMLINEATUS TRIDECEMLINEATUS (MITCHILL)

THIRTEEN-LINED GROUND SQUIRREL

*Sciurus tridecem-lineatus* Mitchill, Medical Repository (n. s.) 6 (21): 248, 1821.

*Arctomys hoodii* Sabine, Linn. Soc. London. Trans. 13: 590, 1822 (Carlton House, Saskatchewan).

*Arctomys tridecemlineata* Harlan, Fauna Amer., p. 164, 1825.

*Spermophilus tridecemlineatus* Audubon and Bachman, Quad. North Amer. 1: 294, 1849.

[*Citellus*] *tridecemlineatus* Trouessart, Cat. Mamm., Sup., p. 341, 1904.

*Type*.—None designated. "Brought by Professor Douglas, of the United States Military Academy, from the region bordering the sources of the river Mississippi, in November 1820" (Mitchill, l. c.). *Type locality* fixed in "central Minnesota" by J. A. Allen (1895b, p. 338).

*Range*.—Southern parts of Alberta, Saskatchewan, and Manitoba; northern Montana; eastern parts of North Dakota, South Dakota, and Nebraska; northeastern Kansas; northern Missouri; all of Iowa; most of Minnesota and Wisconsin; Lower Peninsula of Michigan; northern parts of Illinois and Indiana; and southwestern Ohio. North to Athabaska Landing, Alberta; east to Fairfield County, Ohio; south to central Kansas; west to Red Deer, Alberta, and St. Mary Lake, Mont. (fig. 9). *Zonal range*: Transition and Upper Austral.

*External characters*.—Size large; coloration dark; all light stripes continuous, not broken into spots; larger than *C. t. texensis* and averaging more blackish (less reddish). Occasional specimens in winter pelage are almost as reddish as *texensis*, but always larger.

*Cranial characters*.—Skull large (for the species); somewhat similar to that of *C. washingtoni washingtoni* but differing in the characters of the subgenus; narrower brain case; longer rostrum; zygomata less spreading; postorbital processes shorter and slenderer; anterior premolar relatively smaller; upper incisors shorter and stouter.

*Color*.—*Summer pelage* (July–September): Sides of nose cinnamon buff; eye ring pinkish buff; cheeks mixed fuscous and cinnamon buff; ear rim and sides of neck cinnamon or ochraceous tawny; dark dorsal stripes dark fuscous or fuscous black, the five median ones each with a row of squarish or rectangular buffy white spots down the center; light dorsal stripes buffy white; front legs and feet cinnamon buff; hind legs mikado brown or russet, the feet cinnamon buff; tail above, fuscous black, mixed with sayal brown and bordered with pinkish buff; tail beneath, russet or mikado brown at base, shading to ochraceous buff or cinnamon buff toward tip, more or less mixed, especially near tip, with fuscous black; lower sides cinnamon buff, shading to pinkish buff on throat and belly; chin creamy white. *Winter pelage* (April and May): Similar to the summer pelage but dark dorsal stripes mars brown or chest-

nut brown, and light dorsal stripes creamy white rather than buffy white.

*Measurements.*—Average of 10 adult males from Fort Snelling and Elk River, Minn.: Total length, 284.9 (274–297); tail vertebrae, 104.7 (90–132); hind foot, 39.8 (38–41). Average of 10 adult females from Minnesota and Wisconsin: Total length, 267.9 (239–285); tail vertebrae, 93.6 (80–103); hind foot, 37.3 (35–40). *Skull:* Average of 10 adults from Elk River and Fort Snelling, Minn.: Greatest length, 44 (43.2–45.8); palatilar length, 20.5 (20–21);

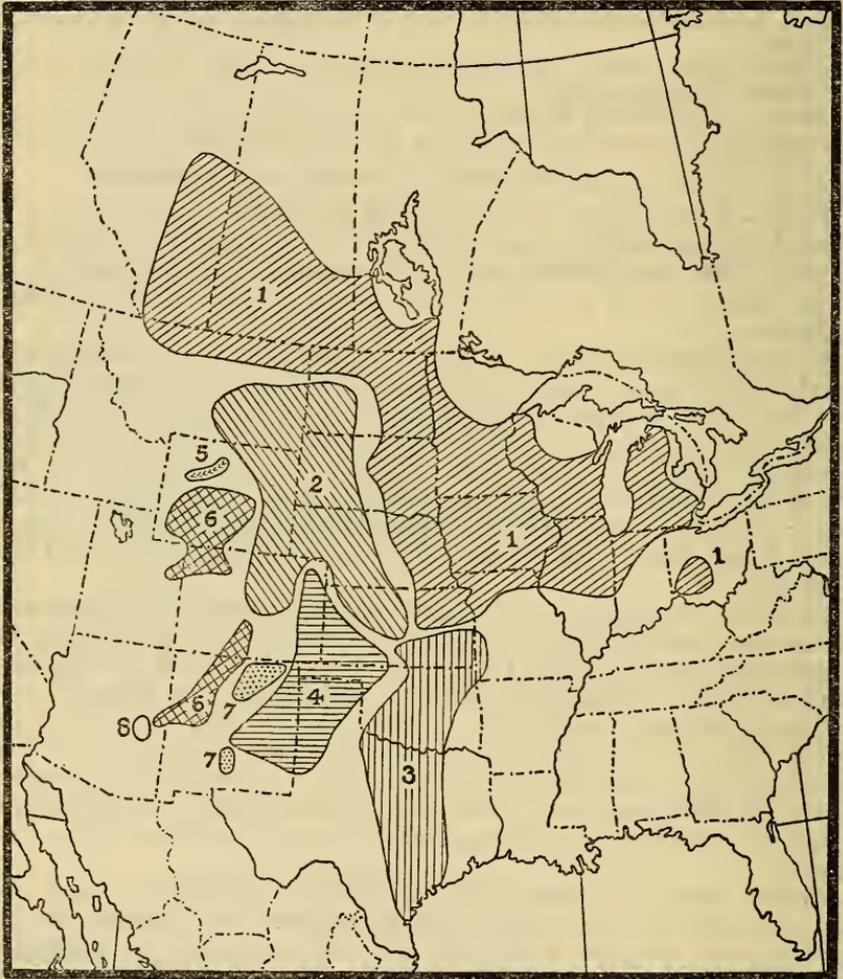


FIGURE 9.—Distribution of the subspecies of *Citellus tridecemlineatus*: 1, *C. t. tridecemlineatus*; 2, *C. t. pallidus*; 3, *C. t. teagensis*; 4, *C. t. arenicola*; 5, *C. t. alleni*; 6, *C. t. parvus*; 7, *C. t. hollisteri*; 8, *C. t. monticola*.

zygomatic breadth, 25.1 (24.4–26.4); cranial breadth, 17.6 (17.3–18); interorbital breadth, 8.1 (7.7–9); postorbital constriction, 11 (10.2–11.4); length of nasals, 15.3 (14.3–16.8); maxillary tooth row, 7.9 (7.6–8.4). Average of 8 adult females from same localities: Greatest length, 42.7 (41.2–44.2); palatilar length, 19.7 (18.5–21); zygomatic breadth, 24.3 (23–25.5); cranial breadth, 17.3 (16.3–18.1); interorbital breadth, 8.3 (7.3–9.1); postorbital constriction, 11.1 (10.5–11.8); length of nasals, 14.9 (14.2–15.6); maxillary tooth row, 7.8 (7.4–8.2).

*Weight.*—Wade (1930, p. 170) gives the weights of four males as ranging from 170–243 g; of four females, from 144–211 g.

*Remarks.*—The typical race of the striped ground squirrel has an extensive range in the upper Mississippi Valley and the northern plains and is an abundant animal over most of its range. Considerable individual and seasonal variation is shown in nearly every series of this race, specimens taken in midsummer being the darkest and those taken in late spring decidedly paler and more tawny (less brownish). Specimens from near the northern limits of its range (Edmonton, Alberta) are not appreciably different from typical specimens, but those from northwestern Montana (St. Mary Lake and Choteau) are somewhat paler, thus showing approach to *C. t. pallidus*. Intergradation with the latter is shown also, by numerous specimens from central North Dakota, South Dakota, Nebraska, and Kansas. A large series from Knoxville, Iowa, shows approach to *texensis* in slightly smaller size and in the reddish tone of the under side of the tail. The under parts are more strongly buffy than in either *tridecemlineatus* or *texensis*. A small series from Onaga, Kans., is typical. The large series examined from Leavenworth and Douglas Counties, Kans., is intermediate between *tridecemlineatus* and *texensis*, but a little nearer to the former; the one summer specimen is clearly *tridecemlineatus*; the skulls are intermediate in size.

*Specimens examined.*—Total number, 445, as follows:

- Alberta:** Chief Mountain Lake, 1; Red Deer, 3; South Edmonton, 5; Sturgeon River (25 miles north of Edmonton), 1.
- Illinois:** Chicago, 15;<sup>82</sup> Kansas, 1; Riverdale (Cook County), 1;<sup>82</sup> Warsaw, 1; Waukegan, 1;<sup>82</sup> Wheatland Township (Will County), 1.<sup>82</sup>
- Indiana:** La Fayette (8 miles east), 1; Lake Village (Newton County), 1;<sup>83</sup> Logansport, 1;<sup>83</sup> Montezuma (Parke County), 1;<sup>83</sup> Notre Dame, 2;<sup>84</sup> Pine Station (Lake County), 1; Roseland (St. Joseph County), 1;<sup>84</sup> Royal Center, 2; South Bend, 1;<sup>85</sup> Wabash Township (Tippecanoe County), 1.
- Iowa:** Ames, 1;<sup>85</sup> Burlington, 22; Knoxville, 16; Luxemburg, 1.<sup>82</sup>
- Kansas:** Douglas County, 12;<sup>85</sup> Fort Leavenworth, 1; Fort Riley, 1; Lawrence, 8;<sup>85</sup> Leavenworth, 5;<sup>85</sup> Onaga, 5.
- Manitoba:** Carberry, 34; Red River Settlement, 1.
- Michigan:** Alma, 2;<sup>82</sup> Ann Arbor, 13;<sup>82</sup> Birchwood Beach (Berrien County), 1;<sup>82</sup> Boyne Falls (Charlevoix County), 1;<sup>82</sup> Boyne Valley (Charlevoix County), 1;<sup>83</sup> Byron (Shiawassee County), 2;<sup>82</sup> Chelsea, 1;<sup>82</sup> Douglas Lake (Cheboygan County), 1;<sup>86</sup> Harbert (Berrien County), 1;<sup>82</sup> Higgins Lake (Roscommon County), 1;<sup>82</sup> Le Roy (Osceola County), 2;<sup>82</sup> Lucerne (Oscoda County), 1;<sup>82</sup> Manchester, 1;<sup>82</sup> Montmorency County, 2;<sup>82</sup> Otsego County, 1;<sup>82</sup> Portage Lake (Washtenaw County), 3;<sup>85</sup> Warren Preserve (Berrien County), 2;<sup>82</sup> Waterloo (Jackson County), 1.<sup>82</sup>
- Minnesota:** Brown Valley, 3; Elk River, 21; Fort Snelling (Hennepin County), 4;<sup>87</sup> Geneva Lake (Freeborn County), 1; Germantown (Marshall County), 1; Goodhue, 3;<sup>82</sup> Hutchinson, 1; Ortonville, 2; Princeton (Benton County), 1; Waseca County, 1.<sup>82</sup>
- Montana:** Bear Paw Mountains (20 miles southeast of Fort Assiniboine), 1; Blackfoot Agency (Glacier County), 1; Choteau, 1; Johnson Lake (Roosevelt County), 1; St. Mary Lake, 3; St. Mary River (15 miles below St. Mary Lake), 1; Zortman (Phillips County), 1.
- Nebraska:** Broken Bow, 1;<sup>88</sup> Columbus, 4; Glen (Sioux County), 1;<sup>88</sup> North Platte, 2;<sup>88</sup> Verdigris, 1.
- North Dakota:** Bismarek, 2; Bottineau, 1; Braddock, 2;<sup>92</sup> Buford (Williams County), 3; Casselton, 1; Crosby, 1; Dawson (Kidder County), 1; Devils Lake, 1;<sup>82</sup> Drayton, 1; Ellendale, 1; Fairmount, 7; Fargo, 3; Fort Berthold (McLean County), 1; Fort Buford (Williams County), 3; Grand Forks, 4; Grafton, 3; Grinnell (Williams County), 1; Hankinson, 2; Harwood (Cass County), 1; Lidgerwood, 1; Ludden (Dickey County), 2; Minot, 4;<sup>92</sup> Oakes, 5; Old Fort Union (near Buford), 4; Pembina, 9; Portland, 1; Starkweather, 2; Steele, 8;<sup>92</sup> Streeter, 1; Stump Lake, 2; Townier, 3; Turtle Creek (near Washburn), 3; Valley City, 3; Walhalla, 1; Washburn, 1; Yellowstone River (mouth), 2; Zeeland, 1.

**Ohio:** Bainbridge (Ross County), 9;<sup>89</sup> Circleville, 1;<sup>82</sup> Lancaster, 6.  
**Saskatchewan:** Grenfell, 1; Indian Head, 3; Livelong, 2;<sup>90</sup> Prince Albert, 2;<sup>92</sup> Wingard, 4.  
**South Dakota:** Flandreau, 2; Fort Randall (Gregory County), 1; Mitchell, 2; Pierre, 2; Lake Traverse, 5; Vermillion, 1;<sup>91</sup> White Lake (Aurora County), 1.  
**Wisconsin:** Bay Settlement (Brown County), 3;<sup>84</sup> Beaver Dam, 14;<sup>82</sup> Benderville (Brown County), 1;<sup>84</sup> Bussyville (=Sumner, Jefferson County), 1; Camp Douglas (Juneau County), 1; Clark County, 2;<sup>82</sup> Danbury (Burnett County), 2; Delavan, 1; Devils Lake (Sauk County), 1; Endeavor, 2; Friendship, 2; Green Lake, 4; Herbster (Bayfield County), 2; Holcombe (Chippewa County), 2; Kelly Lake (Oconto County), 1; La Crosse, 2; Long Lake (Washburn County), 1; Mather (Juneau County), 2; Namakagon Lake (Bayfield County), 1; Nashotah (Waukesha County), 2; Orienta (Bayfield County), 2; Prescott, 1; Racine, 7; Rib Hill (Marathon County), 6; Solon Springs, 2; Stevens Point, 1; Three Falls (15 miles west of Crivitz, Marinette County), 2;<sup>84</sup> Wauzeka (Crawford County), 1.

CITELLUS TRIDECIMLINEATUS TEXENSIS (MERRIAM)

TEXAS STRIPED GROUND SQUIRREL

*Spermophilus tridecemlineatus texensis* Merriam, Biol. Soc. Wash. Proc. 12: 71, Mar. 24, 1898.

*Spermophilus (Ictidomys) tridecemlineatus badius* Bangs, New England Zool. Club Proc. 1: 1, 1899 (Stotesbury, Mo.).

[*Citellus tridecemlineatus*] *texensis* Trouessart, Cat. Mamm., Sup., p. 342, 1904.

*Type*.—Collected at Gainesville, Tex., April 15, 1886, by George H. Ragsdale; male adult, skin and skull, no. 186471, U. S. Natl. Mus. (formerly no.  $\frac{2}{3}\frac{117}{647}$ , Merriam collection).

*Range*.—Prairie region of middle eastern portions of Texas and Oklahoma; north to southeastern Kansas (Cairo and Garden Plain); east to southwestern Missouri (Stotesbury and Golden City); south to Bee County, Tex.; west to Vernon, Tex., and Mount Scott, Wichita Mountains, Okla. (fig. 9). *Zonal range*: Lower Austral.

*External characters*.—Similar to *C. t. tridecemlineatus* but smaller, with upper parts and under side of tail paler and more reddish.

*Cranial characters*.—Skull similar to that of *tridecemlineatus* but smaller, and relatively broader across brain case and zygomata.

*Color*.—*Winter pelage* (April): Dark dorsal stripes russet or mars brown; light stripes and spots creamy white; eye ring buffy white; lower sides and under parts cream color or pinkish buff; fore and hind feet pinkish buff or buffy white; tail above, same color at base as the back, but more or less overlaid with whitish hairs, and shading to cinnamon buff on distal portion, the hairs on sides of tail tiller buff at tips with a subterminal band of fuscous black; tail beneath, russet in center, edged and more or less overlaid with tiller buff. *Summer pelage* (August): Dark strikes chestnut brown; light stripes buffy white to pale cinnamon buff.

*Measurements*.—Average of 10 adults (4 males, 6 females) from Texas (Vernon, Wichita Falls, Henrietta, Gainesville): Total length, 256 (227–267); tail vertebrae, 92 (80–102); hind foot, 34 (33–36). *Skull*: Average of 11 adults (4 males, 7 females) from Texas (Gainesville, Vernon, Henrietta, Richmond,

<sup>82</sup> Univ. Michigan Mus. Zool.

<sup>83</sup> P. F. Hickie collection.

<sup>84</sup> Univ. of Notre Dame.

<sup>85</sup> Kansas Univ. Mus. Nat. Hist.

<sup>86</sup> Cornell Univ. Mus.

<sup>87</sup> Amer. Mus. Nat. Hist.

<sup>88</sup> Univ. Nebraska.

<sup>89</sup> Cleveland Mus. Nat. Hist.

<sup>90</sup> William T. Shaw collection.

<sup>91</sup> South Dakota State Biol. Survey.

<sup>92</sup> Field Mus. Nat. Hist.

Wichita Falls) : Greatest length, 40.4 (39.5–42.1) ; palatilar length, 19 (18.2–20) ; zygomatic breadth, 24.2 (23.1–25.8) ; cranial breadth, 17.8 (16.9–18.9) ; interorbital breadth, 8 (7–8.4) ; postorbital constriction, 11.9 (10.7–12.6) ; length of nasals, 14.3 (13.2–15.6) ; maxillary tooth row, 7.5 (7.3–8).

*Remarks.*—The Texas ground squirrel is a well-marked form, characterized especially by its reddish coloration. Specimens from Kiowa and Cairo, Kans., and Alva, Okla., are paler than typical specimens, thus showing approach to *C. t. arenicola*. A single specimen from Dimmitt, Tex., seems referable here, although on geographical grounds it should be within the range of *arenicola*.

The series from Stotesbury, Mo., which formed the basis of "radius" of Bangs is closely similar in color to *texensis*, winter specimens being practically indistinguishable; summer specimens are slightly darker (more blackish) and the skulls are slightly larger. The series is thus intermediate between *texensis* and *tridecemlineatus* but with too slight characters for recognition by name.

*Specimens examined.*—Total number, 72, as follows:

**Kansas:** Anderson County, 1; <sup>93</sup> Belle Plaine, 2; Columbus, 1; <sup>93</sup> Garden Plain, 1; Independence, 2.<sup>92</sup>  
**Missouri:** Golden City, 5; Stotesbury (Vernon County), 12; <sup>94</sup> Washburn (Barry County), 6.  
**Oklahoma:** Apache, 1; Arnettville, 1; <sup>95</sup> Fort Reno (Canadian County), 2; Lawton, 1; Mount Scott P. O. (Comanche County), 14; Noble, 2; <sup>95</sup> Norman, 2; <sup>93</sup> Orlando, 3.  
**Texas:** Cooke County, 1; Gainesville, 2; Henrietta, 3; Richmond, 4; Vernon, 4; Wichita Falls, 2.

#### CITELLUS TRIDECEMLINEATUS ARENICOLA HOWELL

##### SANDHILL STRIPED GROUND SQUIRREL

*Citellus tridecemlineatus arenicola* Howell, Biol. Soc. Wash. Proc. 41: 213, Dec. 18, 1928.

*Type.*—Collected at Pendennis, Kans., April 22, 1897, by J. Alden Loring; male adult, skin and skull; no. 87686, U. S. Natl. Mus. (Biological Survey collection) (orig. no. 3988).

*Range.*—Southwestern Kansas, eastern Colorado, northwestern Texas, northwestern Oklahoma, and eastern New Mexico; north to Logan County, Colo.; east to Barber County, Kans.; south to Lubbock, Tex., and Roswell, N. Mex.; west to Lincoln County, N. Mex. (fig. 9). *Zonal range:* Upper Sonoran.

*External characters.*—Similar to *C. t. pallidus*, but smaller and paler, the dark dorsal stripes snuff brown instead of sepia; similar, also, to *C. t. texensis*, but smaller and much paler.

*Cranial characters.*—Skull similar to that of *pallidus*, but averaging slightly smaller, except in breadth of the cranium; nasals shorter.

*Color.*—*Winter pelage* (April 23): Dark dorsal stripes snuff brown or Prout's brown; light dorsal stripes and spots white, sometimes faintly washed with pale buff; tail above, cinnamon buff, shaded with bister, becoming fuscous or fuscous black on distal end, strongly margined with buffy white; tail beneath, tawny on median basal portion, shading to cinnamon on distal portion, edged with fuscous black and tipped with buffy white; feet, under parts, and

<sup>93</sup> Kansas Univ. Mus. Nat. Hist.

<sup>94</sup> Mus. Comp. Zool.

<sup>95</sup> Field Mus. Nat. Hist.

sides buffy white. *Summer pelage* (Lipscomb, Tex., July 8): Dark dorsal stripes cinnamon brown; light stripes tulleul buff; under parts and sides dull buffy white; hind feet pinkish buff; tail as in winter pelage.

*Measurements*.—Average of 8 adults (4 males, 4 females) from type locality: Total length, 238 (214–295); tail vertebrae, 77.7 (71–83); hind foot, 32.2 (31–34). *Skull*: Average of 8 adult males (3 from Pendennis, 5 from Morton County, Kans.): Greatest length, 39.1 (38.3–40.3); palatilar length, 17.9 (17.5–18.5); zygomatic breadth, 23.2 (22.6–24.3); cranial breadth, 17.2 (16.8–17.6); interorbital breadth, 8.1 (7.4–8.9); postorbital constriction, 12 (11.6–12.5); length of nasals, 13.9 (13.2–14.9); maxillary tooth row, 7.2 (6.8–7.7). Average of 8 adult females from same localities: Greatest length, 38.1 (37.3–39.7); palatilar length, 17.7 (17.1–18); zygomatic breadth, 22.7 (21.9–23.4); cranial breadth, 17 (16.2–17.8); interorbital breadth, 7.6 (7–8.2); postorbital constriction, 13.5 (13–14.4); length of nasals, 13.5 (13–14.4); maxillary tooth row, 7 (6.7–7.2).

*Remarks*.—This race is the palest of all the forms of this species. The dorsal stripes are more reddish in tone than in *pallidus*, in this respect showing approach to *texensis*. Intergradation with *pallidus* occurs in eastern Colorado, northwestern Kansas, and western Nebraska. A large series from Baca County, southeastern Colorado, is typical of *arenicola* in color, but the skulls are like those of *pallidus*.

*Specimens examined*.—Total number, 110, as follows:

- Colorado: Akron, 1; <sup>96</sup>Eureka Hill (Cheyenne County), 1; Greeley, 1; Kit Carson County, 1; <sup>96</sup>Leroy (Logan County), 1; Monon (Baca County), 6; <sup>97</sup>Springfield (Baca County), 8; <sup>97</sup>Sterling, 5; Tuttle (Kit Carson County), 1; Washington County, 2; <sup>98 98</sup>Wray, 3; <sup>98</sup>Wray (20 miles northwest), 1. <sup>98</sup>Kansas: Banner (Gove County), 2; <sup>98</sup>Calro (Pratt County), 1; Clark County, 1; <sup>98</sup>Coolidge (Hamilton County), 1; <sup>98</sup>Fowler (Meade County), 2; <sup>98</sup>Grinnell (Gove County), 2; <sup>1</sup>Kiowa, 4; Medicine Lodge 1; Morton County, 13; <sup>98</sup>Oakley, 1; Oanica (Kearney County), 2; <sup>98</sup>Pendennis (Lane County), 10; Phillipsburg, 1; <sup>98</sup>Scott City, 3; Wallace (Wallace County), 1. <sup>98</sup>New Mexico: Cabra Springs (6 miles north, San Miguel County), 1; Chico Springs (Colfax County), 1; Clayton, 1; Folsom, 1; Loveless Lake (10 miles northwest of Capitan Mountains, Lincoln County), 1; Preston (Colfax County), 1; Roswell, 1; San Jon (Quay County), 5; <sup>2</sup>Tucumcari (25 miles west), 1. Oklahoma: Alva, 4; <sup>8</sup>Woodward, 3. Texas: Dimmitt (20 miles south), 1; Lipscomb, 3; Lubbock, 2; Mobeetie, 1; Texline (20 miles east), 1; Washburn, 6.

### CITELLUS TRIDECIMLINEATUS PALLIDUS (ALLEN)

#### PALLID STRIPED GROUND SQUIRREL

[*Spermophilus tridecemlineatus*] var. *pallidus* Allen, Monog. North Amer. Rodentia, p. 872, 1877.

[*Citellus tridecemlineatus*] *pallidus* Trouessart, Cat. Mamm., Sup., p. 341, 1904.  
*Spermophilus tridecemlineatus olivaceus* Allen, Amer. Mus. Nat. Hist. Bull. 7: 337, 1895 (Custer, S. Dak.).

*Type*.—None designated; type locality, mouth of the Yellowstone River, Mont.<sup>4</sup>

*Range*.—Plains of Montana east of the Rocky Mountains, eastern Wyoming, northeastern Colorado, northwestern Kansas, western

<sup>96</sup> Univ. Michigan Mus. Zool.

<sup>97</sup> E. R. Warren collection.

<sup>98</sup> Kansas Univ. Mus. Nat. Hist.

<sup>99</sup> Colorado Mus. Nat. Hist.

<sup>1</sup> Kansas State Agr. College.

<sup>2</sup> Cleveland Mus. Nat. Hist.

<sup>3</sup> Two in Field Mus. Nat. Hist.

<sup>4</sup> Cf. Allen (1895b, p. 338) where the type region is designated as "plains of the Lower Yellowstone River." In order to fix the type locality more definitely, specimen number 16237, U. S. National Museum, taken Aug. 18, 1857, at the mouth of the Yellowstone, by F. V. Hayden, is here selected as a lectotype.

parts of Nebraska and South Dakota, and southwestern North Dakota; north to the Missouri River in Montana, east to the Missouri in North Dakota, and to about the 100th meridian in Nebraska and Kansas; south to Ellis and Trego Counties, Kans., and Colorado Springs, Colo.; west to Casper and Laramie, Wyo., and to Canadian Creek (North Park) and Como (South Park), Colo. (fig. 9). *Zonal range*: Upper Sonoran and Transition.

*External characters*.—Similar to *C. t. tridecemlineatus* but smaller and paler.

*Cranial characters*.—Skull similar to that of *tridecemlineatus*, but decidedly smaller and with relatively broader rostrum and brain case.

*Color*.—*Summer pelage* (August and September): Dark dorsal stripes sepia; light stripes and spots grayish white or cartridge buff; front and sides of face pinkish buff, washed with pinkish cinnamon on nose; front feet pinkish buff; hind feet cartridge buff, the legs cinnamon buff or washed with cinnamon or clay color; tail above and beneath, cinnamon buff, mixed with fuscous black and overlaid with pinkish buff; under parts and lower sides cartridge buff, shaded with pinkish buff. *Winter pelage* (May 21): Very similar to the summer pelage, but light dorsal stripes and spots more whitish (less buffy); sides of face, neck, and body pinkish buff.

*Measurements*.—Average of 10 adult males from eastern Montana: Total length, 244.2 (214–255); tail vertebrae, 80.7 (60–91); hind foot, 32.9 (31–35). Average of 10 adult females from same section: Total length, 232.5 (220–252); tail vertebrae, 82.2 (76–91); hind foot, 32.3 (31–35). *Skull*: Average of 7 adult males from eastern Montana: Greatest length, 39.5 (38–42.1); palatilar length, 18.5 (17.5–19.5); zygomatic breadth, 23.2 (22.3–24.6); cranial breadth, 17.1 (16.6–18.3); interorbital breadth, 7.6 (7.2–8.4); postorbital constriction, 11 (10–11.7); length of nasals, 14.8 (14–15.4); maxillary tooth row, 7 (6.7–7.3). Average of 10 adult females from same section: Greatest length, 38.8 (36.4–41.3); palatilar length, 18.2 (17–19.8); zygomatic breadth, 23.1 (21.9–24.7); cranial breadth, 16.8 (15.8–17.9); interorbital breadth, 7.3 (6.6–7.8); postorbital constriction, 10.6 (9.9–11.3); length of nasals, 14.3 (13.4–15.7); maxillary tooth row, 7 (6.5–7.4).

*Remarks*.—The pallid ground squirrel is distinctly smaller and paler than the typical race, but larger and darker than *C. t. parvus* and *C. t. arenicola*. It was described from the plains of the lower Yellowstone, at the northern edge of its range. On the north side of the Missouri River, directly opposite the mouth of the Yellowstone, the squirrels are darker and are referable to *tridecemlineatus*. Intergradation with the typical race occurs over a considerable strip of country in the central parts of North Dakota, South Dakota, Nebraska, and Kansas. Southward, in eastern Colorado and northwestern Kansas, this race intergrades with *arenicola*. Doubtless it intergrades also with *C. t. alleni* in the foothills of the Bighorn Mountains, but no specimens are available from that section. Four specimens from Casper, Wyo., are typical of *pallidus* in color, but the skulls are smaller and more like those of *parvus*.

The type series of "*olivaceus*" from Custer, S. Dak., has been compared with a large series of typical *pallidus* and is found to agree closely with it.

*Specimens examined.*—Total number, 314, as follows:

- Colorado:** Barr (Adams County), 3;<sup>5</sup> Boulder, 1; Canadian Creek (Jackson County), 5; Colorado Springs, 20;<sup>6</sup> Como (Park County), 5; Deer Trail Arapahoe County), 1;<sup>6</sup> Denver, 2; Divide (Teller County), 6;<sup>6</sup> Elbert (6 miles south), 1;<sup>7</sup> Elbert County (between Mattison and Resolis), 1;<sup>6</sup> Elkhorn (Larimer County), 1; Fort Collins, 1; Golden, 2; Horsetail Creek (Weld County), 5;<sup>5</sup> Loveland, 22; Manitou, 1;<sup>7</sup> Pawnee Buttes (Weld County), 2; Puma City (Park County), 1;<sup>6</sup> Simla (12 miles east), 1;<sup>7</sup> Tarryall Creek (Park County), 1;<sup>6</sup> Valmont (Boulder County), 1.
- Kansas:** Atwood (10 miles east and 27 miles west), 2;<sup>8</sup> Colby, 1; Ellis, 1; Hays, 1; Logan County, 3<sup>8</sup>; North Solomon River (Graham County), 1; Solomon River (Graham County), 1; Trego County, 10; Woodston (Rooks County), 3.<sup>8</sup>
- Montana:** Albion (Carter County), 1; Baker (10 miles north, 4; Billings, 1; Broadus (10 miles northeast), 1; Capitol (Carter County), 2; Cohagen (16 miles southeast, Garfield County), 2; Crow Agency (Bighorn County), 5; Fort Custer (Bighorn County), 2; Intake (Dawson County), 1; Little Bighorn River (2 miles north of Wyoming border), 1; Little Dry Creek (Garfield County), 1; Medicine Rocks (Carter County), 3; Melstone (Musselshell County), 1; Pilgrim Creek (10 miles east of Broadus), 1; Piney Buttes, 1; Powderville (Powder River County), 6; Pryor Mountains (Carbon County), 1; Roy (20 miles northeast, Fergus County), 1; Terry, 1; Tilyou Ranch (26 miles above mouth of Yellowstone River), 3; Wibaux (17 miles south and 17 miles west), 11.
- Nebraska:** Antioch (Sheridan County), 2;<sup>7</sup> Beaver City, 1; Birdwood Creek (Lincoln County), 1; Blue River (near head, Hamilton County), 1; Callaway, 1; Cody (Cherry County), 1; Eustis (Frontier County), 1; Gavin (Custer County), 1;<sup>7</sup> Gothenberg, 1; Grand Island, 1;<sup>9</sup> Hackberry Lake (Cherry County), 2;<sup>7</sup> Homerville (Gosper County), 1; Kelso (Hooker County), 2;<sup>7</sup> Kennedy (Cherry County), 8; Myrtle (Lincoln County), 1; Niobrara River (Cherry and Sheridan Counties), 2; North Platte, 6; O'Fallons Bluff (Lincoln County), 1; Sidney, 1; Valentine, 21.
- North Dakota:** Fort Clark (Oliver County), 4; Glen Ullin (Morton County), 6; Heart River (at head), 1; Mandan, 2; Mikkelson (Billings County), 1; Oakdale (Dunn County), 2; Sentinel Butte (Valley County), 2.
- South Dakota:** Ardmore (Fall River County), 1; Buffalo Gap (Custer County), 2; Buffalo Valley (Stanley County), 1; Bull Springs (near Custer), 10;<sup>6</sup> Custer, 21;<sup>10</sup> Diamond S Ranch (near Rapid City), 1;<sup>6</sup> Elk Mountain (Custer County), 1; Minichaduza River (Todd County), 1; Pactola (Pennington County), 1; Pine Ridge Agency (Shannon County), 1; Spring Creek (Custer County), 1.<sup>10</sup>
- Wyoming:** Bear Lodge Mountains (Crook County), 1; Casper, 4; Cassa (Platte County), 1; Cheyenne, 13; Chugwater (Platte County), 3;<sup>9</sup> Douglas, 3; Fort Laramie, 1; Fort Russell (Laramie County), 1; Islay (Laramie County), 1; Medicine Bow Mountains, 1; Moorcroft (Crook County), 6; Newcastle (and 25 miles southwest), 3; Pine Bluffs (Laramie County), 3; Spoon Butte (Goshen County), 1; Sundance, 1.

CITELLUS TRIDECIMLINEATUS ALLENI (MERRIAM)

BIGHORN STRIPED GROUND SQUIRREL

*Spermophilus tridecemlineatus alleni* Merriam, Biol. Soc. Wash. Proc. 12: 71, Mar. 24, 1898.

[*Citellus tridecimlineatus*] *alleni* Trouessart, Cat. Mamm., Sup., p. 341, 1904.

*Type.*—Collected near head of Canyon Creek, west slope of Big-horn Mountains, Wyo. (altitude 8,000 feet), September 11, 1893, by Vernon Bailey; male adult, skin and skull, no. 56050, U. S. Natl. Mus. (Biological Survey collection) (orig. no. 4383).

<sup>5</sup> Colorado Mus. Nat. Hist.

<sup>6</sup> E. R. Warren collection.

<sup>7</sup> Univ. Michigan Mus. Zool.

<sup>8</sup> Kansas Univ. Mus. Nat. Hist.

<sup>9</sup> Cleveland Mus. Nat. Hist.

<sup>10</sup> Amer. Mus. Nat. Hist.

*Range*.—The Bighorn Mountains and Bighorn Basin, Wyo.; south to head of Red Canyon, near Miners Delight, Fremont County, and west to New Fork of Green River (fig. 9). Reported also from Franks Butte, near head of Sage Creek, Park County, Wyo. *Zonal range*: Transition.

*External characters*.—Similar in coloration to *C. t. tridecemlineatus* but slightly paler and much smaller; size of *C. t. parvus* but much darker.

*Cranial characters*.—Skull smaller than that of *tridecemlineatus* or *C. t. pallidus*; similar to that of *parvus* but relatively longer, with smaller audital bullae and much longer nasals.

*Color*.—*Summer pelage* (September): Dark dorsal stripes mummy brown; light spots and stripes grayish white; nose and front of face cinnamon buff; sides of face pinkish buff, washed with fuscous; front feet pinkish buff; hind feet tilleul buff, the thighs cinnamon buff, washed with snuff brown; tail above, like the back at base, shading to fuscous black on terminal half, edged with tilleul buff or buffy white; tail beneath, cinnamon or pinkish cinnamon, overlaid and edged with buffy white and fuscous black; under parts and lower sides soiled whitish, washed with pinkish buff.

*Measurements*.—Average of 3 adults (1 male, 2 females) from Bighorn Mountains and Bighorn Basin: Total length, 206.3 (203-211); tail vertebrae, 74 (73-75); hind foot, 31 (30-32). *Skull*: Average of 3 adults (1 male, 2 females) from same localities: Greatest length, 36.4 (35.8-36.8); palatilar length, 16.4 (16.2-16.5); zygomatic breadth, 19.9 (19.5-20.1); cranial breadth, 16 (16-16.1); interorbital breadth, 7.5 (7.1-7.7); postorbital constriction, 11.3 (10.8-11.6); length of nasals, 13.2 (12-14.5); maxillary tooth row, 6.6 (6.4-6.8).

*Remarks*.—The Bighorn ground squirrel is an inhabitant of mountains and foothills, and is decidedly darker than the races living on the plains. The limits of its range are not well known.

*Specimens examined*.—Total number, 6, as follows:

Wyoming: Bighorn Basin (head of Kirby Creek, Hot Springs County), 1; Bighorn Mountains (west slope, near head of Canyon Creek), 2; Miners Delight (near head of Twin Creek, Fremont County), 1; New Fork of Green River (Lander Road), 2.

#### CITELLUS TRIDECEMLINEATUS HOLLISTERI BAILEY

##### HOLLISTER'S STRIPED GROUND SQUIRREL

*Citellus tridecemlineatus hollisteri* Bailey, Biol. Soc. Wash. Proc. 26: 131, May 21, 1913.

*Type*.—Collected in Elk Valley, Mescalero Indian Reservation, Sacramento Mountains, N. Mex. (8,000 feet altitude), September 11, 1902, by Vernon Bailey; female adult, skin and skull, no. 119025, U. S. Natl. Mus. (Biological Survey collection) (orig. no. 7963).

*Range*.—Sacramento Mountains, N. Mex., and mountain valleys of northeastern New Mexico; western limits of range not known (fig. 9). *Zonal range*: Transition.

*External characters*.—Similar to *C. t. alleni*, but dark dorsal stripes slightly more reddish and light stripes tinged with buff, the median pair of light stripes usually continuous; hind feet washed with buff.

*Cranial characters*.—Skull similar to that of *alleni*, but with heavier and more widely spreading zygomatics; larger than that of *C. t. parvus*.

*Color.*—*Summer pelage* (September): Dark dorsal stripes chestnut brown; crown same color mottled with whitish spots; a broad whitish or buffy eye ring; front of face tawny olive; sides of nose pinkish buff; light dorsal stripes and spots grayish white, faintly tinged with buff; front legs and feet cinnamon buff; hind legs cinnamon; hind feet dull white, washed with buff; tail (above and below) chestnut brown at base, becoming black on distal half, overlaid with tulleul buff; under parts and sides pinkish buff or pale cinnamon buff.

*Measurements.*—Average of 5 adult females from type locality: Total length, 211.2 (200–232); tail vertebrae, 71.8 (60–85); hind foot, 30.7 (30–32). *Skull:* Average of 4 adult females: Greatest length, 36.1 (35–37.4); palatilar length, 16.7 (16–17); zygomatic breadth, 20.7 (19.3–21.7); cranial breadth, 15.9 (15.3–16.4); interorbital breadth, 7.3 (6.5–7.8); postorbital constriction, 11.6 (11.2–12.2); length of nasals, 13.2 (12.8–13.8); maxillary tooth row, 6 (5.9–6.2).

*Remarks.*—This race seems to have a discontinuous range; described from the Sacramento Mountains, southern New Mexico, it proves to occupy, also, the mountain valleys in the northeastern part of the State north nearly or quite to the Colorado line, where it intergrades with *C. t. arenicola* of the plains region to the eastward. The specimens from this region have the dark dorsal stripes more brownish (less reddish) than in the typical series. Further collecting in central New Mexico may result in partly connecting this range. Although very similar in external appearance to *alleni*, of the Big-horn Mountains, Wyo., the range of *hollisteri* is separated from the range of that form by a wide area in western Colorado mainly occupied by *parvus*.

Bailey (1931, p. 119) has referred the specimens from Moreno Valley to *alleni*, on the strength of their close resemblance to that race in color; however, the skulls of these New Mexico specimens agree closely with those of *hollisteri* and differ from those of *alleni* in heavier build and more widely spreading zygomata. It seems preferable, therefore, by reason of their proximity to the type region of *hollisteri*, to refer them to that race.

*Specimens examined.*—Total number, 17, as follows:

**New Mexico:** Cimarron (35 miles northwest), 1; Las Vegas (12 miles north), 1; Maxwell, 1;<sup>11</sup> Mescalero Reservation (Elk Valley, Sacramento Mountains), 7; Mora (10 miles south), 2; Moreno Valley (Colfax County), 5.

#### CITELLUS TRIDECIMLINEATUS MONTICOLA HOWELL

##### ARIZONA STRIPED GROUND SQUIRREL

*Citellus tridecemlineatus monticola* Howell, Biol. Soc. Wash. Proc. 41: 214, Dec. 18, 1928.

*Type.*—Collected at Marsh Lake, White Mountains, Ariz. (9,000 feet altitude), June 15, 1915, by Edward A. Goldman; male adult, skin and skull, no. 209255, U. S. Natl. Mus. (Biological Survey collection) (orig. no. 22616).

*Range.*—Known only from the type locality (fig. 9). *Zonal range:* Transition.

*External characters.*—Similar to *C. t. alleni* but upper parts slightly and under side of tail decidedly more reddish. Similar to

<sup>11</sup> Reading (Pennsylvania) Public Mus.

*C. t. parvus*, but larger; coloration of upper parts and under side of tail darker; under parts more buffy (less whitish). Compared with *C. t. hollisteri*: Upper parts paler, the light dorsal stripes more whitish (less buffy); under side of tail more reddish.

*Cranial characters*.—Skull similar to that of *hollisteri*, but nasals shorter; decidedly larger than that of *parvus*, but with relatively smaller molars; similar to that of *alleni* but with heavier and more spreading zygomata.

*Color*.—*Summer pelage* (June 15): Dark dorsal stripes chestnut brown; light stripes and spots, and eye ring, creamy white; front feet pinkish buff; hind feet cartridge buff, the thighs pinkish cinnamon or mikado brown; tail above, pinkish cinnamon on proximal third, the remainder fuscous black, broadly edged with cartridge buff (the basal portion of the hairs likewise cartridge buff); tail beneath, russet, bordered with fuscous black and tipped with cartridge buff; under parts and lower sides cartridge buff.

*Measurements*.—Average of 7 adults (4 males, 3 females) from type locality: Total length, 221.7 (214–227); tail vertebrae, 78 (70–81); hind foot, 30.4 (29–32). *Skull*: Average of 4 adult males: Greatest length, 37 (37–37.1); palatilar length, 17.3 (17–17.5) zygomatic breadth, 21.4 (21.1–21.7); cranial breadth, 16.6 (16.3–17); interorbital breadth, 7.8 (7.3–8); postorbital constriction, 11.7 (11.3–12.3); length of nasals, 12.7 (12.5–13); maxillary tooth row, 5.9 (5.7–6.1). Average of 3 adult females: Greatest length, 35.8 (35–36.1); palatilar length, 16 (15.5–16.5); zygomatic breadth, 20 (one specimen); cranial breadth, 15.9 (15.7–16.4); interorbital breadth, 7.2 (7.1–7.3); postorbital constriction, 12 (11.7–12.2); length of nasals, 12.3 (11.8–12.8); maxillary tooth row, (5.6–6.2).

*Remarks*.—This race is similar to *alleni* of the Bighorn Mountains, Wyo.; it resembles, also, *hollisteri* of eastern New Mexico, but is somewhat paler and differs in the color of the under side of the tail. Typical specimens are known only from the higher parts of the White Mountains, Ariz.; specimens from Springerville, at the base of the mountains and from the Datil Mountains, N. Mex., agree with *parvus* in the coloration of the tail and in skull characters, but are about as dark as typical *monticola*, thus indicating intergradation between these forms.

*Specimens examined*.—Total number, 7, from Marsh Lake, White Mountains, Ariz.

#### CITELLUS TRIDECIMLINEATUS PARVUS (ALLEN)

##### LEAST STRIPED GROUND SQUIRREL

*Spermophilus tridecimlineatus parvus* Allen, Amer. Mus. Nat. Hist. Bull. 7: 337, Nov. 8, 1895.

[*Citellus tridecimlineatus*] *parvus* Trouessart, Cat. Mamm., Sup., p. 341, 1904.

*Type*.—Collected at Kennedy's Hole, Uncompahgre Indian Reservation (20 miles northeast of Ouray, Uintah County), Utah, May 2, 1895, by W. W. Granger; male adult, skin and skull, no.  $\frac{10838}{9135}$ , Amer. Mus. Nat. Hist. (orig. no. 537).

*Range*.—Uncompahgre Plateau, eastern Utah and desert regions of southwestern Wyoming, northwestern and south-central Colorado, and west-central New Mexico; north to Natrona County, Wyo.; east to Independent Rock, Wyo., south to St. Augustine Plains, N. Mex.; and west to Springerville, Ariz. (fig. 9). *Zonal range*: Upper Sonoran.

*External characters.*—Similar to *C. t. arenicola* but much smaller and slightly darker; median pair of light dorsal stripes more or less broken into spots; tail not reddish beneath. Compared with *C. t. pallidus*: Size much smaller and coloration more reddish.

*Cranial characters.*—Skull similar to that of *C. t. alleni* but slightly smaller and relatively broader, with shorter nasals and larger auditory bullae; decidedly smaller than those of *arenicola* and *pallidus*.

*Color.*—*Winter pelage* (type, May 2): Front of face dull pinkish buff; top of head sayal brown, mottled with grayish white; eye ring buffy white; dark dorsal stripes walnut brown; light stripes and spots creamy white; sides of head and neck and front feet washed with pinkish buff; hind feet dull whitish; tail above and below, pinkish cinnamon, shading to fuscous on distal half, overlaid with grayish white; under parts white. *Summer pelage* (Bitter Creek, Wyo., August): Dark dorsal stripes snuff brown; tail heavily overlaid on both surfaces with cinnamon buff.

*Measurements.*—Average of 5 adult males from Utah (the type and 4 others from Ouray): Total length, 189 (170–202); tail vertebrae, 71 (69–72); hind foot, 28 (27–29). Average of 12 adults from Bitter Creek, Wyo., and Snake River, Colo.: 204.6 (189–228); tail vertebrae, 76.7 (65–87); hind foot, 32.9 (28–31). *Skull*: Average of 4 adult males (type from Utah; 2 from Bitter Creek, Wyo.; one from Snake River, Colo.): Greatest length, 35.3 (34.6–36.2); palatilar length, 15.5; zygomatic breadth, 20.2 (19.7–21); cranial breadth, 16.7 (16.4–17.3); interorbital breadth, 7.1 (6.9–7.3); postorbital constriction, 11.4 (11.1–11.7); length of nasals, 11.7 (10.5–12.7); maxillary tooth row, 6.2 (5.9–6.4). Average of 4 adult females (Ouray, Utah, Bitter Creek, Wyo., and Routt County, Colo.): Greatest length, 33.9 (33.2–34.3); palatilar length, 14.9 (14.5–15.5); zygomatic breadth, 19.4 (19.1–19.7); cranial breadth, 16.1 (15.8–16.4); interorbital breadth, 7.1 (7–7.2); postorbital constriction, 11.2 (11–11.5); length of nasals, 10.5 (10–11); maxillary tooth row, 6.2 (6–6.4).

*Weight.*—One female weighed 6 ounces.

*Remarks.*—This subspecies is the smallest of the races of *C. tridecemlineatus* and is about as pale as *arenicola* from western Kansas. Its range is imperfectly known at present and appears to be discontinuous. A good series from Bitter Creek, southwestern Wyoming, appears to be typical and a few specimens from northwestern Colorado are also referred to this race, although they average darker; and those from Lay, Rangely, and Mud Springs might on the basis of color be referred to *alleni*. Their skulls, however, are small, like those of *parvus*. A series from the San Luis Valley, southern Colorado, is provisionally referred to *parvus*, although they show some color variations that may necessitate their separation when it is possible to compare them with a good series of topotypes. Intergradation with *C. t. monticola* of southern Arizona is indicated by small series from Datil Mountains, N. Mex., and Springerville, Ariz.; with *alleni* by specimens from New Fork of Green River, Wyo., and with *pallidus* by specimens from Casper, Wyo. (referred to *pallidus*).

*Specimens examined.*—Total number, 69, as follows:

Arizona: Springerville, 4.

Colorado: Antonito, 2; Axial Basin (12 miles southeast of Lay), 2; Escalante Hills (Moffat County), 1; Fort Garland, 3; Medano Ranch (Alamosa County), 2;<sup>12</sup> Mosca (Alamosa County), 1;<sup>12</sup> Muddy Creek (Huerfano County), 1;<sup>12</sup> Mud Springs (Garfield County, 30 miles southeast of Meeker), 4;<sup>12</sup> Rangely (Rio Blanco County), 2; San Acacio (Costilla County), 3;<sup>12</sup> San Luis Lakes (Alamosa County), 1;<sup>12</sup> Snake River (Mof-

fat County), 5; <sup>12</sup> <sup>13</sup> Two Bar Spring (western Moffatt County), 1; <sup>13</sup> Westcliffe (Custer County), 7.

New Mexico: Datil Mountains (12 miles northwest of Datil), 2; St. Augustine Plains (near Monica Spring), 2.

Utah: Fruitland, 3; <sup>16</sup> Ouray (12 miles southwest), 4; <sup>16</sup> Uncompahgre Indian Reservation, 4. <sup>14</sup> <sup>15</sup>

Wyoming: Big Sandy (Sublette County), 1; Big Sandy Creek (Lander Road), 1; Bitter Creek (Kinney Ranch, Sweetwater County), 9; <sup>14</sup> Green River, 1; Independent Rock (mouth of Dry Creek, Natrona County), 1; Myersville (Fremont County), 1; Sun (Natrona County), 1.

#### CITELLUS MEXICANUS (ERXLEBEN)

[Synonymy under subspecies]

*Specific characters.*—Size large; hind foot 38–51 mm; tail about 40 percent of the total length; skull length, 41–52.5 mm. Skull similar to that of *C. tridecemlineatus* but considerably larger; brain case less elongate, more nearly square; zygomata more widely expanded; audital bullae large and smoothly rounded. Ears broad and low, rising 3–5 mm above crown. Coloration of upper parts varying from wood brown or buffy brown to sayal brown or snuff brown, marked with squarish white spots arranged in linear rows, usually nine in number, the spots sometimes partly confluent, at other times more or less obsolete; head buffy brown or wood brown, sprinkled with white, the nose clay color or cinnamon buff; feet, sides, and under parts white to pinkish buff; tail above, mixed fuscous and grayish or buffy white; tail beneath, avellaneous to cinnamon buff, more or less obscured by grayish or buffy white.

#### CITELLUS MEXICANUS MEXICANUS (ERXLEBEN)

MEXICAN GROUND SQUIRREL

(Pls. 25, *C*; 30, *C*)

[*Sciurus*] *mexicanus* Erxleben, Syst. Regni Anim. 1: 428, 1777.

*Citellus mexicanus* Lichtenstein, Darstel. Saugt., plate 31 (and accompanying text), 1827–1834.

*Spermophilus mexicanus* Wagner, Schreber's Säugt., Sup., 3: 250, 1843.

*Otospermophilus mexicanus* Brandt, Cl. Phys.-Math. Acad. Sci. St. Petersburg Bull. 2: 379, 1844.

*Citellus mexicanus* Merriam, Biol. Soc. Wash. Proc. 16: 80, 1903.

*Type.*—None designated; type locality fixed at Toluca, Mexico, by Mearns (1896, p. 443).

*Range.*—Central Mexico, from northern Jalisco and Guanajuato south to southern Puebla (fig. 10). *Zonal range:* Lower Sonoran.

*External characters.*—Size large; hind foot, 46.5–51 mm; skull length, 45.3–52.5; coloration averaging darker, with more buffy sides and under parts than in *C. m. parvidens*.

*Cranial characters.*—Skull similar to that of *C. tridecemlineatus tridecemlineatus* but much larger; brain case relatively broader; audital bullae larger and more inflated.

*Color.*—Upper parts buffy brown, sayal brown, or snuff brown, the dorsum covered with numerous squarish white spots arranged in nine linear rows (sometimes with indications of another pair of lines

<sup>12</sup> E. R. Warren collection.

<sup>13</sup> Colo. Mus. Nat. Hist.

<sup>14</sup> Amer. Mus. Nat. Hist.

<sup>15</sup> Field Mus. Nat. Hist.

<sup>16</sup> Carnegie Mus.

on lower sides), the middle row usually somewhat narrower than the others; the lines sometimes irregular and broken in middle of back, and spots sometimes confluent on some of the rows; head buffy brown, with whitish tips to some of the hairs; nose and front of face cinnamon buff or clay color; eye ring white; feet pinkish buff or cartridge buff; tail above, mixed fuscous and buffy white, with

some of the body color near the base; tail beneath, avellaneous to cinnamon buff, bordered with fuscous and edged with buffy white.

*Measurements.*—Average of 10 adults and subadults from central Mexico (states of Hidalgo, Queretaro, Guanajuato, and Mexico): Total length, 349.6 (322-380); tail vertebrae, 144.6 (124-166); hind foot, 48.4 (46.5-51). *Skull:* Average of 13 adults (6 males, 7 females) from Queretaro, Guanajuato, and Jalisco: Greatest length, 49 (45.3-52.5); palatilar length, 23.5 (22-24.2); zygomatic breadth, 28.9 (27-30.3); cranial breadth, 20.4 (19.3-21.1); interorbital breadth, 10.4 (9.6-11.1); postorbital constriction, 14 (13.2-14.8); length of nasals, 17.8 (15.8-20.1); maxillary tooth row, 9.8 (9.3-10.5).

*Remarks.*—This strikingly marked ground squirrel was one of the first North American species to be recognized, having been named by Erxleben in 1777. It is common on the tableland

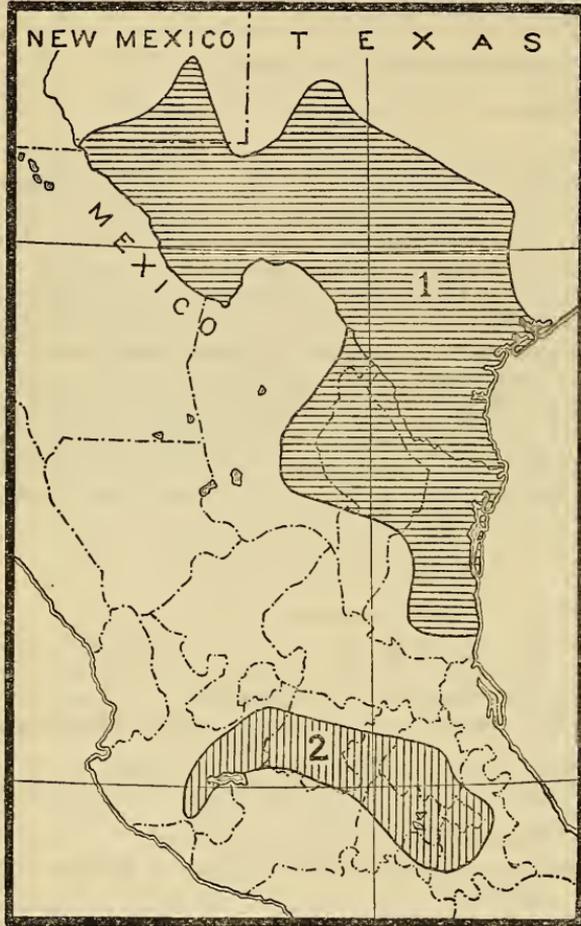


FIGURE 10.—Distribution of the subspecies of *Citellus mexicanus*; 1, *C. m. parvidens*; 2, *C. m. mexicanus*.

of central Mexico, occupying an area lying mainly south of the range of *C. pilosoma*. It resembles this species only slightly, being much larger and more heavily spotted. It varies considerably in color; the extremes of coloration might be designated as a brown phase and a drab or olivaceous phase, but there are several intermediate shades in any large series of specimens.

*Specimens examined.*—Total number, 31, as follows:

Guanajuato: Celaya, 1; Silao, 3; Irolo, 1; Marques, 1.

Jalisco: Atemajac, 7; Lagos, 2; Zapotlan, 6.

Mexico: Tlalpam (Federal District), 4.

Puebla: Atlixco, 1; San Andres Chalchicomula, 1; San Martin, 1.

Queretaro: Tequisquiapan, 2.

Tlaxcala: Huamantla, 1.

## CITELLUS MEXICANUS PARVIDENS (MEARNS)

## RIO GRANDE GROUND SQUIRREL

*Spermophilus mexicanus parvidens* Mearns, U. S. Natl. Mus. Proc. 18: 443, May 23, 1896 (advance sheets issued, Mar. 25, 1896).

[*Citellus mexicanus*] *parvidens* Elliot, Field Columb. Mus., Zool. Ser. 4: 146, 1904.

*Type*.—Collected at Fort Clark, Kinney County, Tex., March 21, 1893, by E. A. Mearns; male adult, skin and skull, no. 63073, U. S. Natl. Mus. (orig. no. 2312).

*Range*.—Northeastern Mexico, western Texas, and southeastern New Mexico; north to Roswell, N. Mex. and Borden County, Tex.; east to Austin and Rockport, Tex.; south to southern Tamaulipas; west to central Coahuila and extreme western Texas (El Paso) (fig. 10). *Zonal range*: Lower Sonoran.

*External characters*.—Similar to *C. m. mexicanus* but decidedly smaller; coloration averaging paler, with less buff on under parts and hind legs.

*Cranial characters*.—Skull similar to that of *mexicanus* but decidedly smaller.

*Color*.—Upper parts varying from wood brown to sayal brown or snuff brown, with nine usually distinct linear rows of large white spots; head same color as back, flecked with white; nose patch cinnamon buff; eye ring white; sides of face and neck smoke gray; sides of body and under parts creamy white or cartridge buff; hind legs cinnamon buff to cartridge buff; feet pinkish buff or buffy white; tail above, mixed fuscous and buffy white; tail beneath, cartridge buff or pinkish buff, more or less overlaid with buffy white.

*Measurements*.—Average of 12 adults from type locality: Total length, 300.8 (280–313); tail vertebrae, 118.3 (110–126); hind foot, 40.9 (38–43). *Skull*: Average of 17 adults (9 males, 8 females) from type locality: Greatest length, 43 (41.1–44.8); palatal length, 20.7 (19.5–22); zygomatic breadth, 25.3 (23.5–27.1); cranial breadth, 18.6 (17.8–19.5); interorbital breadth, 9.4 (8.2–10.5); postorbital constriction, 12.7 (12–14.6); length of nasals, 15.1 (13.5–16.2); maxillary tooth row, 8 (7.3–8.9).

*Remarks*.—This northern race of *mexicanus* is distinctly larger than the typical race, and, like it, shows a great amount of variation in color; the majority of specimens of *parvidens* are paler than *mexicanus* but some in the brown phase are not appreciably different in color.

Although actual intergradation with *mexicanus* is not shown by the material in hand, it seems highly probable that additional collecting in Mexico, particularly in San Luis Potosi, will result in the discovery of intergrades.

*Specimens examined*.—Total number, 225, as follows:

Coahuila: Las Vacas, 1; Monclova, 1; Sabinas, 1; Saltillo, 8.

New Mexico: Carlsbad, 2; Roswell, 3.

Nuevo Leon: Montemorelos, 1; Pesqueria Grande (probably near Monterey), 1; Santa Catarina, 1.

Tamaulipas: Bagdad, 3; Camargo, 2; Mier, 5; Nuevo Laredo, 1; Reynosa, 1; Victoria, 1.

Texas: Adams (Pecos County), 2; Alice, 1; Alpine, 1; Altuda (Brewster County), 7; Beeville, 1; Big Spring, 2; Brownsville, 20; Cameron County, 7; Carrizo Springs, 2; Colorado, 4; Comstock, 3; Coneho County, 1; Corpus Christi, 9;<sup>17</sup> Cotulla, 3; Del Rio, 3; Devils River (at mouth), 2; Eagle

<sup>17</sup> Three in Field Mus. Nat. Hist.

Pass, 3; East Painted Cave (near mouth of Pecos River), 1; Fort Clark (Kinney County), 33; Fort Lancaster (Crockett County), 6; Fort Stockton (25 miles west), 2; Juno (Val Verde County), 1; La Hacienda (10 miles southeast of Hidalgo), 1; Langtry (Val Verde County), 15; Laredo, 5; Lomita Ranch (Hidalgo County), 2; Lozier (Terrell County), 1; Marathon, 1; Mason, 1; Monahans (Ward County), 4; Norias (Kenedy County), 2;<sup>18a</sup> Pecos, 4; Port Isabel, 14;<sup>18</sup> Rio Grande City, 5; Rock Springs (10 miles west), 1; Rockport, 1;<sup>18</sup> Samuels (Val Verde County), 4; San Angelo 1; Sau Diego, 5; Sarita (Kenedy County), 3;<sup>18a</sup> Sheffield (Pecos County), 3; Stanton, 3; Sycamore Creek (Val Verde County), 3.

#### CITELLUS SPILOSOMA GROUP

#### CITELLUS SPILOSOMA (BENNETT)

[Synonymy under subspecies]

*Specific characters*.—Size small to medium; hind foot, 28–38 mm; tail, 55–88; skull length, 34.1–42.7. Skull similar to that of *C. tridecemlineatus*, but relatively shorter and broader, especially the rostrum and interorbital region; audital bullae much larger.

*Color*.—Upper parts drab, cinnamon drab, avellaneous, smoke gray, fawn, wood brown, snuff brown, or verona brown, more or less spotted with squarish white spots; tail above, usually similar to the back, darkened at the tip with fuscous black; tail beneath, pinkish buff, pinkish cinnamon, vinaceous cinnamon, or cinnamon buff.

#### CITELLUS SPILOSOMA SPILOSOMA (BENNETT)

#### BENNETT'S SPOTTED GROUND SQUIRREL

(Pls. 25, A; 30, A)

*Spermophilus spilosoma* Bennett, Zool. Soc. London Proc. 1833: 40.

*Citellus spilosoma* Allen, Amer. Mus. Nat. Hist. Bull. 20: 209, 1904.

*Lectotype* (Thomas, 1927, p. 548).—No. 53.8.29.5, British Museum; male, skin (without skull), from an unknown locality; in the absence of any definite information relative to the type, the type locality is hereby fixed at Durango, Durango.<sup>19</sup>

*Range*.—Central Mexico, from Durango City south to Aguascalientes; east to San Luis Potosi (city) (fig. 11). *Zonal range*: Lower Sonoran.

*External characters*.—Size large; tail long, with considerable black at distal end; dorsal spotting rather fine, becoming obsolete on the anterior part of the body.

*Cranial characters*.—Skull similar in shape to that of *C. mexicanus mexicanus* but much smaller; similar to that of *C. tridecemlineatus texensis* but with broader brain case and larger audital bullae.

*Color*.—(Jesus Maria, San Luis Potosi, Sept. 10): Upper parts fawn color, moderately speckled, chiefly on hinder back, with small squarish spots of white; eye ring buffy white; sides of face, neck, and shoulders washed with smoke gray; front feet pinkish buff; hind feet cartridge buff; tail above, vinaceous fawn, the hairs on the distal half with a broad subterminal band of black, tipped with buffy white; tail beneath, vinaceous cinnamon, more or less obscured by black and edged with buffy white; under parts white, tinged with pale buff.

<sup>18</sup> Field Mus. Nat. Hist.

<sup>18a</sup> Acad. Nat. Sci. Philadelphia.

<sup>19</sup> See remarks, p. 123.

A specimen from Durango, Durango, June 27 (said to agree closely with the type) is slightly more reddish above than this description, the general tone about vinaceous fawn.

*Measurements.*—Average of 11 adults from Aguascalientes and San Luis Potosi (Jesus Maria and Hacienda La Parada): Total length, 238.4 (230–250); tail vertebrae, 77.7 (71–83); hind foot, 35.8 (34–37). *Skull:* Average of 11 adults (2 males, 9 females) from San Luis Potosi and Zacatecas: Greatest length, 40.9 (39.3–42.7); palatilar length, 18.8 (18.2–19.8); zygomatic breadth 24.5 (23–26.6); cranial breadth, 18.6 (17.8–20); interorbital breadth, 8.8 (8–10); post-orbital constriction, 14.2 (13.1–15.9); length of nasals, 14.2 (13.7–15.2); maxillary tooth row, 7.6 (7–8).

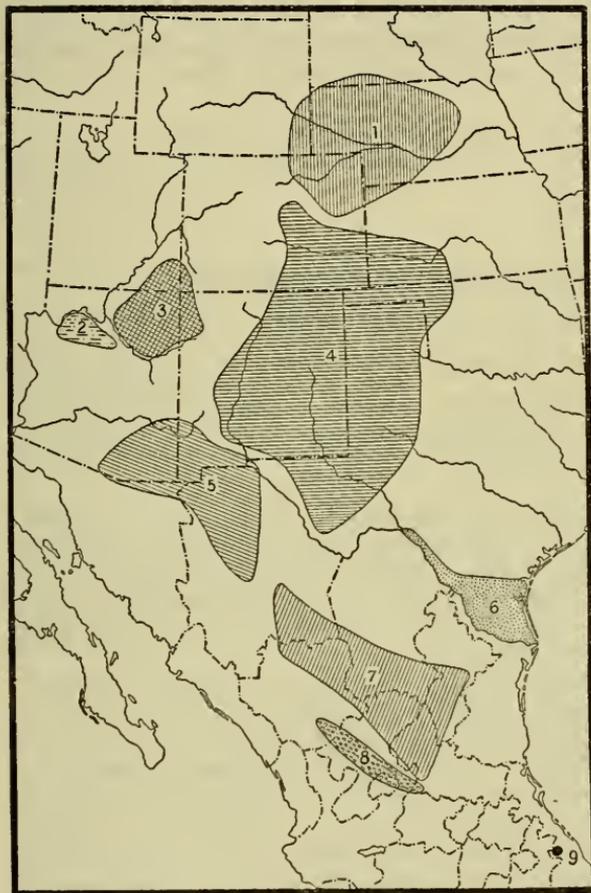


FIGURE 11.—Distribution of *Citellus perotensis* and of the subspecies of *C. spilosoma*: 1, *C. s. obsoletus*; 2, *C. s. pratensis*; 3, *C. s. cryptospilotus*; 4, *C. s. major*; 5, *C. s. canescens*; 6, *C. s. amniclens*; 7, *C. s. pallescens*; 8, *C. s. spilosoma*; 9, *C. perotensis*.

However, since the species is not known to occur to the westward of the Sierra Madre in Mexico, this statement cannot be taken literally.

At the time the species was described (1833), few expeditions had been made to the region where it lives. Capt. Beechey's expedition, however, remained at San Blas, on the coast of Tepic, from December 8, 1827, to February (?), 1828, and Mr. Lay, the naturalist of the expedition, "visited and remained for a long time at Tepic, 54 miles from San Blas, inland" (Hooker and Arnott, 1841, p. 1), and it seems not at all improbable that the type specimens may have been obtained by this expedition.

In order to settle, if possible, the identity of typical *spilosoma*, several specimens of this species from central Mexico and several from

*Remarks.*—Originally described in 1833 from an unknown locality, this species has never been fully characterized and it seems impossible to discover the exact source of the type specimens. They were stated by the describer to have been obtained in "that part of California which adjoins to Mexico." Baird (1857, p. 322) states: "this species was first described from specimens collected on the western coast of Mexico", but does not give the source of his information. However, since the species is not known to occur to the westward of the Sierra Madre in Mexico, this statement cannot be taken literally.

southern Arizona (*C. s. canescens*) were forwarded to the late Oldfield Thomas, at the British Museum, who kindly compared them with the cotypes in that institution. He wrote as follows:

After a careful comparison it appears to me that the large form from [Durango], central Mexico (No. 94596, U. S. N. M.) most nearly agrees with the type of *spilosoma*, though unfortunately the latter has no skull to give an absolute indication of size; the feet, however, would appear to be quite as large as in your specimen. The only difference is that our specimens are of a rather stronger cinnamon colour anteriorly, especially on the crown, less greyish.

This decision will involve no shifting of names, since the other described forms in the group are all recognizably different from this race.

*Specimens examined*.—Total number, 39, as follows:

**Aguascalientes:** Chicalote, 14.  
**Durango:** Durango, 13.  
**San Luis Potosi:** Jesus Maria, 2.  
**Zacatecas:** Berriozabal, 10.

#### CITELLUS SPILOSOMA PALLESCENS HOWELL

##### PALLID SPOTTED GROUND SQUIRREL

*Citellus spilosoma pallescens* Howell, Biol. Soc. Wash. Proc. 41: 212, Dec. 18, 1923.

*Type*.—Collected at La Ventura, Coahuila, August 10, 1896, by E. W. Nelson and E. A. Goldman; male adult, skin and skull, no. 79535, U. S. Natl. Mus. (Biological Survey collection) (orig. no. 10016).

*Range*.—North-central Mexico from southern Chihuahua (Santa Rosalia) southward to San Luis Potosi and eastward to southern Nuevo Leon (Doctor Arroyo) (fig. 11). *Zonal range*: Lower Sonoran.

*External characters*.—Similar to *C. s. spilosoma*, but paler. Compared with *C. s. canescens*: Size larger; tail longer, with more black on distal half; dorsal spotting finer.

*Cranial characters*.—Skull similar to that of *spilosoma* but averaging smaller, with shorter, broader rostrum and nasals; larger than that of *C. s. canescens*, with longer, narrower rostrum.

*Color*.—(August specimens, topotypes): Upper parts wood brown or drab, finely speckled, chiefly on hinder back, with white; tail above, light pinkish cinnamon on proximal half, the distal half bordered with fuscous black and edged with buffy white; tail beneath, pinkish buff, bordered with fuscous black and buffy white; otherwise as in *spilosoma*.

*Measurements*.—Average of 12 adults from La Ventura and Carneros, Coahuila: Total length, 242.6 (232–253); tail vertebrae, 84.8 (76–92); hind foot, 35.7 (34.5–37). *Skull*: Average of 10 adults from La Ventura: Greatest length, 40.1 (38.9–41.1); palatilar length, 17.9 (17.2–18.5); zygomatic breadth, 23.8 (22.9–24.5); cranial breadth, 18.6 (18.2–19); interorbital breadth, 8.4 (7.8–8.9); postorbital constriction, 14 (12.8–15.1); length of nasals, 13.6 (13–14.5); maxillary tooth row, 7.5 (7.1–8.1).

*Remarks*.—This pale race, occupying the plains of north-central Mexico, is most nearly related to *spilosoma*. It intergrades with both *spilosoma* and *canescens*. A large series from Santa Rosalia, Chihuahua, is nearest to *pallescens*, but shows approach to *canescens* in the coarser spotting of some individuals and in the size and shape of some of the skulls.

*Specimens examined.*—Total number, 75, as follows:

Chihuahua: Escalon, 4; Santa Rosalia, 20.

Coahuila: Carneros, 6; Jaral, 1; <sup>20</sup> La Ventura, 17; Torreon, 6.

Nuevo Leon: Doctor Arroyo, 2.

San Luis Potosi: Hacienda La Parada (about 20 miles northwest of San Luis Potosi), 17; San Luis Potosi, 1.

Zacatecas: Cañitas, 1.

CITELLUS SPILOSOMA CANESCENS (MERRIAM)

APACHE SPOTTED GROUND SQUIRREL

(Pl. 5)

*Spermophilus canescens* Merriam, North Amer. Fauna 4: 38, Oct. 8, 1890.

*Spermophilus spilosoma macrospilotus* Merriam, Ibid., p. 38, (Oracle, Ariz.).

*Anisonyx (Xerospermophilus) canescens* Allen, Amer. Mus. Nat. Hist. Bull. 7: 239, 1895.

*Anisonyx (Xerospermophilus) spilosoma macrospilotus* Allen, loc. cit., p. 239, 1895.

[*Spermophilus spilosoma*] *microspilotus* Elliot, Field Columb. Mus. Pub. Zool. Ser. 2: 96, 1901 (accidental renaming of *macrospilotus*).

*Spermophilus spilosoma arens* Bailey, Biol. Soc. Wash. Proc. 15: 118, 1902 (El Paso, Tex.).

*Citellus spilosoma microspilotus* Elliot, Field Columb. Mus. Pub., Zool. Ser. 4: 144, 145, 1904.

*Citellus spilosoma macrospilotus* Elliot, Field Columb. Mus. Pub., Zool. Ser. 6: 99, 1905.

*Citellus spilosoma canescens* Bailey, North Amer. Fauna 53: 109, 1931.

*Type.*—Collected at Willcox, Cochise County, Ariz., November 16, 1889, by Vernon Bailey; male juv., skin and skull, no.  $\frac{17873}{28410}$ , U. S. Natl. Mus. (Biological Survey collection) (orig. no. 676).

*Range.*—Southeastern Arizona and southwestern New Mexico; south to Chihuahua City, Chihuahua, Mexico; west to Altar Valley, Ariz.; north to Gila Valley (Pima), Ariz.; east to Deming, N. Mex. and Fort Hancock, Tex. (fig. 11). *Zonal range:* Lower Sonoran.

*External characters.*—Similar to *C. s. pallescens*, but smaller, with shorter tail and hind feet; dorsal spots larger, and more numerous on foreback; tail with more black on distal portion.

*Cranial characters.*—Skull similar to that of *pallescens*, but smaller, with shorter, broader rostrum.

*Color.*—*Cinnamon phase* (January): Upper parts fawn color, thickly spotted over most of the back with rather large, quadrangular whitish spots, more or less obscured or obsolete on the foreback; a broad white ring surrounds the eye; sides of nose whitish; sides of body washed with pinkish buff; front feet cartridge buff; hind feet, white; tail above, vinaceous fawn, edged with pinkish buff, the hairs on distal half with a subterminal band of fuscous black; tail beneath, cinnamon buff with a narrow band of fuscous black near the tip; under parts white. Worn specimens in spring (April and May) have the tail considerably darker—dull orange cinnamon. *Drab phase* (May): Upper parts light drab or light cinnamon drab, spotted as in the cinnamon phase; sides whitish or with a very faint wash of pale ivory yellow.

*Measurements.*—Average of 11 adults from Willcox, Ariz.: Total length, 228.5 (210–247); tail vertebrae, 73.8 (67–86); hind foot, 32.1 (30–34). *Skull:* Average of 10 adults (4 males, 6 females) from Willcox and Oracle, Ariz.:

<sup>20</sup> Field Mus. Nat. Hist.

Greatest length, 38.1 (37.5-38.7); palatilar length, 17 (16.3-17.5); zygomatic breadth, 23.2 (23-23.9); cranial breadth, 18.1 (17.6-19.2); interorbital breadth, 8.3 (7.5-8.9); postorbital constriction, 13.8 (13-14.4); length of nasals, 12.8 (11.6-13.5); maxillary tooth row, 7.2 (6.5-7.4).

*Weight*.—Two specimens weighed respectively, 81.5 and 93.4 g.

*Remarks*.—The Apache ground squirrel is readily distinguished from the central Mexican forms (*C. s. pilosoma* and *pallescens*) by the larger and more numerous dorsal spots. Specimens from Chihuahua City are typical, but south of that point intergradation with *pallescens* occurs. Specimens from El Paso and Fort Hancock, Tex., are intermediate between *canescens* and *C. s. major*. The range of this form northward in Arizona apparently is limited by the Mogollon Plateau.

*Specimens examined*.—Total number, 125, as follows:

**Arizona:** Buenos Ayres, Altar Valley, 1; Chiricahua Mountains (2 miles south-east of Moore's Ranch), 1;<sup>21</sup> Fort Bowie (Cochise County), 1; Fort Grant (Graham County), 1; Fort Huachuca, 9; Huachuca Mountains, 3;<sup>21a</sup> La Noria, Santa Cruz River, 1; Mowry, Patagonia Mountains, 2; Oracle (Pinal County), 6; Pima, 1; Tombstone, 2; Tucson (24 miles southeast), 1; Willcox, 24.

**Chihuahua:** Casas Grande, 4; Chihuahua, 15; Lake Palomas, 1; White Water, Mexican boundary line, 1.

**New Mexico:** Apache (Grant County), 1; Deer Creek (Hidalgo County), 2; Deming, 2; Dog Spring (Grant County), 7; Faywood (Grant County), 1; Hachita, 3; Mangos Valley (Grant County), 1; Monument 15, Mexican boundary line, 4; Monument 40, Mexican boundary line, 2; Silver City, 2; Warren, 6;<sup>21a</sup> Whitmire Pass, Playas Valley, 1.

**Texas:** El Paso, 10; Fort Hancock (El Paso County), 9.

#### CITELLUS SPILOSOMA MAJOR (MERRIAM)

##### NEW MEXICO SPOTTED GROUND SQUIRREL

*Spermophilus pilosoma major* Merriam, North Amer. Fauna 4: 39, Oct. 8, 1890.  
*Spermophilus pilosoma marginatus* Bailey, Biol. Soc. Wash. Proc. 15: 118, 1902 (Alpine, Tex.).

[*Citellus pilosoma*] *major* Trouessart, Cat. Mamm., Sup., p. 340, 1904.

*Type*.—Collected at Albuquerque, N. Mex., July 22, 1889, by Vernon Bailey; female adult, skin and skull; no.  $\frac{17114}{24049}$ , U. S. Natl. Mus. (Biological Survey collection) (orig. no. 225).

*Range*.—Eastern New Mexico, western Texas, western Oklahoma, southwestern Kansas and southeastern Colorado; north to Adams and Yuma Counties, Colo.; east to Kinsley, Kans., Woodward, Okla., and Colorado, Tex.; south to Presidio and Brewster Counties, Tex.; west to St. Augustine Plains, N. Mex. (fig. 11.) *Zonal range*: Upper Sonoran.

*External characters*.—Similar to *C. s. canescens*, but hind feet larger; dorsal spots fewer and less distinct.

*Cranial characters*.—Skull similar to that of *canescens*, but larger, with decidedly longer nasals.

*Color*.—Upper parts varying from light cinnamon-drab or avellaneous to fawn color or mikado brown (in worn specimens), sparingly spotted on the back with more or less indistinct white spots; front feet pinkish buff; hind feet buffy white; tail above, usually same color as the back, the hairs on distal portion with a subterminal

<sup>21</sup> Acad. Nat. Sci. Philadelphia.

<sup>21a</sup> Carnegie Mus.

band of fuscous; tail beneath, light pinkish cinnamon, pinkish buff, or light vinaceous cinnamon; under parts and sides white, sometimes washed with cartridge buff.

*Measurements.*—Average of 8 adults (3 males, 5 females) from Albuquerque and Isleta, N. Mex.: Total length, 231.7 (221–245); tail vertebrae, 76.7 (69–80); hind foot, 35.2 (34–36). *Skull:* Average of 10 adult males from New Mexico (Albuquerque, Española, Capitan Mountains) and southern Colorado (La Junta, and Las Animas County): Greatest length, 40.9 (39.7–42.5); palatilar length, 18.6 (18–19.5); zygomatic breadth, 24.3 (23.5–25.6); cranial breadth, 18.9 (17.9–19.9); interorbital breadth, 8.6 (8.1–9.1); postorbital constriction, 13.7 (12.6–14.8); length of nasals, 14.4 (13.5–15.5); maxillary tooth row, 7.6 (7–8). Average of 10 adult females from New Mexico (Albuquerque, Española, Isleta, Carrizozo, Capitan Mountains): Greatest length, 40.4 (39–41.5); palatilar length, 18.2 (17.5–18.8); zygomatic breadth, 24.1 (23.4–24.9); cranial breadth, 18.7 (18.1–19.6); interorbital breadth, 8.5 (7.8–9.1); postorbital constriction, 14 (13.4–14.5); length of nasals, 14.3 (13.2–15.2); maxillary tooth row, 7.5 (6.2–8).

*Remarks.*—This wide-ranging form is distinguished from its nearest neighbors chiefly by its large size. The drab phase is comparatively rare and does not appear in pure form—that is, many of the specimens are more or less intermediate between a drab and a cinnamon phase. Two specimens from 8 miles east of Deming, N. Mex., are typical *major*, while several others from Deming are best referred to *canescens*.

The present form passes insensibly into subspecies *C. s. obsoletus*; most of the specimens from eastern Colorado, north of the Arkansas Valley, are so completely intermediate between the two forms that it is very difficult to say which form they most resemble. The series from Las Animas, Colo., is clearly referable to *major*, the skulls being even larger than skulls of topotypes from New Mexico. Specimens from Tuttle, Wray, and Barr Lake show approach to *obsoletus*.

The series from Alpine, Tex., on which was based the subspecies "*marginatus*" of Bailey, averages slightly darker than typical *major*, all of them being in the cinnamon phase, but some specimens of the two series are indistinguishable; no difference is apparent in the amount of black flecking on the back, which in both forms is very inconspicuous.

*Specimens examined.*—Total number, 172, as follows:

Colorado: Akron, 1;<sup>22</sup> Barr Lake (Adams County), 1;<sup>23</sup> Carrizo Creek (Baca County), 1;<sup>23</sup> Elbert County (between Mattison and Resolis), 1;<sup>24</sup> Foss-ton (Weld County), 2;<sup>24</sup> Hugo, 1; La Junta (18 miles south), 2; Lamar, 3;<sup>23</sup><sup>24</sup> Las Animas, 9; Monon (Baca County), 2;<sup>24</sup> Regnier (Baca County), 1.<sup>23</sup>

Kansas: Morton County, 1;<sup>25</sup> Kinsley, 1.

New Mexico: Alamogordo, 5; Albuquerque, 11; Bear Spring Mountains (north of Magdalena, Socorro County), 4; Cabra Springs (San Miguel County), 1; Capitan Mountains (northwest foothills), 6; Carlsbad ("Eddy"), 7; Carrizozo, 1; Deming (8 miles east), 2; Española, 7; Fort Sumner (8 miles north), 1; Isleta, 4; Lake Valley (Sierra County), 1; Magdalena (10–15 miles southeast), 2; Maxwell, 1;<sup>26</sup> Mesilla, 3;<sup>20</sup><sup>27</sup> Ojo Caliente (northeast of Chloride, Sierra County), 1; Rio Alamosa (15 miles north of Ojo Caliente), 1; Roswell (and 20 and 50 miles north), 17; St. Augustine Plains (Catron County, 12 miles north of Monica Spring), 10; San Jon (Quay County), 1;<sup>28</sup> Santa Rosa, 7.

<sup>22</sup> Univ. Mich. Mus. Zool.

<sup>23</sup> Colorado Mus. Nat. Hist.

<sup>24</sup> E. R. Warren collection.

<sup>25</sup> Kansas Univ. Mus. Nat. Hist.

<sup>26</sup> Acad. Nat. Sci. Philadelphia.

<sup>27</sup> State College, New Mexico.

<sup>28</sup> Cleveland Mus. Nat. Hist.

<sup>29</sup> Reading (Pennsylvania) Public Mus.

Oklahoma: Woodward, 7.

Texas: Alpine, 12; Canadian, 1; Colorado, 2; Lipscomb, 1; Mobeetie, 3; Monahans (Ward County), 15; Miami, 1; Pecos, 4; Presidio County, 1; Toyahvale (Reeves County), 2; Valentine, 3; Van Horn (Culberson County), 1.

CITELLUS SPILOSOMA ANNECTENS (MERRIAM)

PADRE ISLAND GROUND SQUIRREL

*Spermophilus pilosoma annectens* Merriam Biol. Soc. Wash. Proc. 8: 132, Dec. 28, 1893.

[*Citellus pilosoma*] *annectens* Trouessart, Cat. Mamm., Sup., p. 340, 1904.

*Type*.—Collected at "The Tanks," 12 miles from Point Isabel, Padre Island, Tex., August 24, 1891, by Wm. Lloyd; male adult, skin and skull, no.  $\frac{30410}{42396}$ , U. S. Natl. Mus. (Biological Survey collection) (orig. no. 694).

*Range*.—Lower Rio Grande Valley, Tex., and Gulf coast section from the mouth of the river north to Nueces River; Padre and Mustang Islands (fig. 11). *Zonal range*: Lower Sonoran.

*External characters*.—Closely similar in size and coloration to *C. s. major*.

*Cranial characters*.—Skull closely similar to that of *major*, but averaging slightly longer, and slightly broader interorbitally; with slightly narrower brain case; audital bullae smaller.

*Color*.—(Worn summer pelage): Upper parts avellaneous or smoke gray; dorsal spots large but rather indistinct; sides white, sometimes washed with cartridge buff; tail above, like the back, shaded on distal portion with fuscous and edged with pale cartridge buff; tail beneath, cinnamon or light pinkish cinnamon; feet light pinkish cinnamon or pinkish buff; under parts soiled whitish.

*Measurements*.—Average of 6 adults from type locality: Total length, 229 (220–234); tail vertebrae, 64.2 (55–75); hind foot, 35.4 (33–38). *Skull*: Average of 7 adults (6 males, 1 female) from type locality: Greatest length, 41 (40.5–41.5); palatilar length, 18.1 (17.5–19); zygomatic breadth, 23.8 (23.2–24.4); cranial breadth, 18 (17.6–18.5); interorbital breadth, 9 (8.5–9.3); postorbital constriction, 13.1 (12.1–14.1); length of nasals, 14.1 (13.4–14.6); maxillary tooth row, 13.1 (12.1–14.1).

*Remarks*.—The Padre Island ground squirrel is evidently an offshoot of *major* and shows no close relationship to the darker and more finely spotted forms in Mexico. Some form of this species has been reported from various points along the Rio Grande, up as far as the mouth of the Pecos River, but no specimens are available from that part of the valley; therefore it is uncertain whether or not the range of *annectens* meets that of *major*.

*Specimens examined*.—Total number, 30, as follows:

Texas: Mustang Island, 2; <sup>20a</sup>Norias, 2; <sup>20a</sup>Padre Island, 21; Rio Grande River (at mouth), 1; Sarita, 4. <sup>20a</sup>

CITELLUS SPILOSOMA PRATENSIS (MERRIAM)

PARK SPOTTED GROUND SQUIRREL

(Pls. 25, B; 30, B)

*Spermophilus pilosoma pratensis* Merriam, North Amer. Fauna 3: 55, Sept. 11, 1890.

*Spermophilus pilosoma obsidianus* Merriam, North Amer. Fauna 3: 56, 1890 (Cedar Belt, northeast of San Francisco Mountain, Ariz.).

[*Citellus pilosoma*] *pratensis* Trouessart, Cat. Mamm., Sup., p. 340, 1904.

<sup>20a</sup> Acad. Nat. Sci. Philadelphia.

*Type*.—Collected at north base of San Francisco Mountain (pine plateau), Ariz., August 5, 1889, by C. Hart Merriam and Vernon Bailey; female adult, skin and skull, no.  $\frac{174559}{335}$ , U. S. Natl. Mus. (Biological Survey collection) (orig. no. 285).

*Range*.—North-central Arizona, between the Grand Canyon and the Mogollon Plateau; west to Seligman and Aubrey Valley (fig. 11). *Zonal range*: Upper Sonoran and Transition.

*External characters*.—Similar to *C. s. canescens* but smaller, with shorter tail and hind feet; upper parts darker; dorsal spots smaller; tail darker, with more black on distal portion.

*Cranial characters*.—Skull similar to that of *canescens*, but decidedly smaller; much smaller than that of *C. s. major*.

*Color*.—General tone of upper parts near snuff brown or verona brown, many of the hairs, especially on shoulders, tipped with whitish, producing a hoary effect; back thickly sprinkled with small white spots which become less distinct or obsolete on the shoulders; sides of nose and face grayish; eye ring white; sides of body sometimes faintly washed with pale cartridge buff; tail above, dark fawn color or mikado brown, the distal half mainly black or fuscous black, edged with pinkish buff or buffy white; tail beneath, pinkish buff, cinnamon buff, or pinkish cinnamon, more or less mixed with grayish white and fuscous black; feet whitish, washed with cartridge buff; under parts white.

*Measurements*.—Average of 10 adults from San Francisco Mountain and vicinity of Flagstaff, Ariz.: Total length, 195.8 (185–210); tail vertebrae, 61.1 (55–68); hind foot, 30.5 (28–33). *Skull*: Average of 11 adults (3 males, 8 females) from San Francisco Mountain, Flagstaff, and Walnut Canyon: Greatest length, 35.5 (34.1–36.3); palatilar length, 15.7 (15–16.5); zygomatic breadth, 20.9 (20.2–21.7); cranial breadth, 17 (16.4–17.5); interorbital breadth, 7.3 (6.9–8); postorbital constriction, 12.5 (11.5–13.6); length of nasals, 12.1 (11.2–13.2); maxillary tooth row, 6.6 (6.2–7.8).

*Remarks*.—The park spotted ground squirrel is the smallest form in the group. Although most resembling *canescens*, there is no evidence of intergradation with that race, the ranges of the two apparently being separated by the Mogollon Plateau. Intergradation with *major* is suggested, though not clearly shown by three specimens from Gallup and Thoreau, N. Mex., which agree closely with *pratensis* in external characters but have larger skulls. On the Painted Desert, this form passes into the subspecies *C. s. cryptospilotus*.

*Specimens examined*.—Total number, 62, as follows:

**Arizona**: Aubrey Valley (Hualpai Indian Reservation), 1; Deadmans Flat (northeast of San Francisco Mountain), 9;<sup>30</sup> Flagstaff (including 9 miles northwest and 12 miles northeast), 7; Grand Canyon (Bass Camp and Trash Tank), 8; Kendrick Peak (20 miles northwest of Flagstaff), 1; San Francisco Mountain, 20; Seligman, 1; Walnut Canyon (Coconino Natl. Forest), 15.

<sup>30</sup> Mus. Vert. Zool.

## CITELLUS SPILOSOMA CRYPTOSPILOTUS (MERRIAM)

## DESERT SPOTTED GROUND SQUIRREL

*Spermophilus cryptospilotus* Merriam, North Amer. Fauna 3: 57, Sept. 11, 1890.

*Anisomyx (Xerospermophilus) cryptospilotus* Allen, Amer. Mus. Nat. Hist. Bull. 7: 240, 1895.

[*Citellus*] *cryptospilotus* Trouessart, Cat. Mamm., Sup., p. 341, 1904.

*Type*.—Collected at "Tenebito" [=Dinnebito] Wash, Painted Desert, Ariz., August 17, 1889, by C. Hart Merriam; male juv., skin and skull no.  $\frac{17676}{24612}$ , U. S. Natl. Mus. (Biological Survey collection) (orig. no. 374).

*Range*.—Northeastern Arizona, southeastern Utah, southwestern Colorado, and northwestern New Mexico; north to Monticello, Utah; east to Thoreau, N. Mex.; south to Holbrook, Ariz.; west to the Little Colorado River (fig. 11). *Zonal range*: Upper and Lower Sonoran.

*External characters*.—Similar in size to *C. s. pratensis*, but coloration paler and more reddish (less brownish); similar to *C. s. major* but much smaller; dorsal spots smaller and more numerous.

*Cranial characters*.—Skull similar to that of *pratensis*; smaller than that of *major*.

*Color*.—Upper parts fawn color or avellaneous, rather heavily sprinkled on hinder parts back with small whitish spots; sides washed with pinkish buff or cartridge buff; feet cartridge buff; tail above, like the back and edged with pinkish buff with a fuscous patch near the tip; tail beneath, pinkish buff or light pinkish cinnamon; under parts white.

*Measurements*.—Average of 6 adults from Painted Desert, Ariz.: Total length, 199.5 (190–210); tail vertebrae, 65 (58–72); hind foot, 31.8 (31–33). *Skull*: Average of 14 adults from Painted Desert (4) and Oraibi (10): Greatest length, 36.2 (35.1–36.8); palatilar length, 15.9 (14.5–16.5); zygomatic breadth, 21.0 (20.9–22.4); cranial breadth, 17.5 (16.3–18.4); interorbital breadth, 7.9 (7.2–8.6); postorbital constriction, 12.9 (11.9–13.8); length of nasals, 12.5 (11.7–13.5); maxillary tooth row, 7 (6.3–7.4).

*Remarks*.—The desert spotted ground squirrel is closely related to *pratensis*, its nearest neighbor on the west. The series from Winslow, Ariz., indicates intergradation with *major*; specimens in the cinnamon phase agree in color with *cryptospilotus* while others in the drab phase closely resemble *major*; the skulls are somewhat larger than those of typical *cryptospilotus*.

*Specimens examined*.—Total number, 42, as follows:

**Arizona**: Chin Lee (15 miles southwest, Apache County), 1; Holbrook, 7; Oraibi (Navajo County), 13; Painted Desert, 6 (Dinnebito Wash, 1; Moa Ave, 4; Tuba, 1); Winslow, 7.

**Colorado**: McElmo Creek (south of Cortez, Montezuma County), 2.<sup>21</sup>

**New Mexico**: Gallup, 3; Thoreau (McKinley County), 1.

**Utah**: Lockerby (San Juan County), 1; Monticello (San Juan County), 1.

## CITELLUS SPILOSOMA OBSOLETUS (KENNICOTT)

## KENNICOTT'S SPOTTED GROUND SQUIRREL

*Spermophilus obsoletus* Kennicott, Acad. Nat. Sci. Phila. Proc. 1863: 157.

[*Citellus*] *obsoletus* Trouessart, Cat. Mamm., Sup., p. 340, 1904.

<sup>21</sup> Colorado Agr. College.

*Type*.—None designated; Lyon and Osgood (1909, p. 169), list seven specimens in the United States National Museum collection as being the material used by Kennicott; no.  $\frac{3222}{379\frac{2}{3}}$ , U. S. Natl. Mus., is hereby designated as lectotype; ♀, skin and skull; collected 50 miles west of Fort Kearney, Nebr., August 9, 1857, by J. G. Cooper (orig. no. 44).

*Range*.—Sandhill region of Nebraska; north to Todd County, S. Dak.; east to Neligh, Nebr.; south to Tuttle, Colo.; west to Platte County, Wyo., and Greeley, Colo. (fig. 11). *Zonal range*: Upper Sonoran.

*External characters*.—Similar to *C. s. major* but averaging smaller; dorsal spotting less distinct and tending to become obsolete, the white spots usually more distinctly edged with black; drab phase predominating.

*Cranial characters*.—Skull similar to that of *major* but averaging smaller, with smaller audital bullae.

*Color*.—Upper parts smoke gray, light drab, or avellaneous; dorsal white spots of moderate size, but scattered and more or less indistinct, often nearly obsolete; most of the hairs on back tipped with black or fuscous black, these tips tending to form irregular and more or less indistinct spots, especially on hinder back; patch on front of face pinkish cinnamon or light vinaceous cinnamon; sides of nose and eye ring white; sides of body washed with pale cartridge buff; front feet pinkish buff; hind feet whitish, washed with light pinkish cinnamon or cartridge buff; tail above, vinaceous fawn or wood brown, shaded on distal portion with fuscous and edged with cartridge buff; under parts white.

*Measurements*.—Average of 10 adults (5 males, 5 females) from Nebraska: Total length, 214.3 (197–226); tail vertebrae, 64.6 (56–79); hind foot, 31.8 (30–34). *Skull*: Average of 10 adults (5 males, 5 females) from Nebraska: Greatest length, 38.9 (37.7–39.9); palatilar length, 17.4 (16.5–18); zygomatic breadth, 23 (22.2–23.6); cranial breadth, 17.6 (17–18.2); interorbital breadth, 7.8 (7–8.2); postorbital constriction, 13.2 (12.1–13.8); length of nasals, 13.3 (12.5–13.9); maxillary tooth row, 7.2 (6.9–7.5).

*Remarks*.—Kennicott recognized the near relationship of this form to *C. s. pilosoma* when he described it in 1863. Not until recently, however, when large series of specimens from many localities have been obtained, has it become clear that it is connected with the more southern races by a nearly complete series of intergrades.

*Specimens examined*.—Total number, 33, as follows:

**Colorado**: Avalo (10 miles east, Logan County), 1; Greeley, 1; Merino (Logan County), 1; <sup>32</sup> Sterling, 3; Tuttle (Kit Carson County), 1; Wray, 2.

**Kansas**: St. Francis (9 miles northwest), 1.<sup>33</sup>

**Nebraska**: Cherry County, 2; Fort Kearney (50 miles west), 1; Kennedy (Cherry County), 6; Lincoln County, 2; Neligh, 1; O'Fallons Bluff (Lincoln County), 1; Simeon (Cherry County), 1; Valentine, 4.

**South Dakota**: White River (south fork), 1.

**Wyoming**: Little Bear Creek (20 miles southeast of Chugwater), 1; Wheatland, 1; Fort Laramie (Goshen County), 1; Spoon Butte (Goshen County), 1.

<sup>32</sup> Cleveland Mus. Nat. Hist.

<sup>33</sup> Kansas Univ. Mus. Nat. Hist.

## CITELLUS PEROTENSIS (MERRIAM)

## PEROTE GROUND SQUIRREL

(Pls. 25, D; 30, D)

*Spermophilus perotensis* Merriam, Biol. Soc. Wash. Proc. 8: 131, Dec. 28, 1893.  
[*Citellus*] *perotensis* Elliot, Field Columb. Mus. Pub., Zool. Ser. 4: 145, 1904.

*Type*.—Collected at Perote, Vera Cruz, Mexico, June 8, 1893, by E. W. Nelson and E. A. Goldman; female adult, skin and skull, no. 54274, U. S. Natl. Mus. (Biological Survey collection) (orig. no. 4976).

*Range*.—Known only from the extreme eastern border of the Mexican tableland in the vicinity of Perote, Vera Cruz, at an altitude of 7,800 or 7,900 feet; ranges to a point 10 miles south of Perote and eastward to within a few miles of Las Vigas (fig. 11). *Zonal range*: Upper Sonoran.

*External characters*.—Similar to *C. spilosoma pallescens* but larger, with shorter tail; coloration more yellowish (less pinkish); dorsal spots buffy rather than white, smaller and less conspicuous (often nearly obsolete); under parts buffy instead of white; head marked with blackish.

*Cranial characters*.—Skull similar to that of *C. s. spilosoma* but larger, with relatively narrower and higher brain case; audital bullae broader and more flattened; molariform teeth heavier.

*Color*.—(Type, in worn pelage, June 8): General tone of upper parts dull clay color, varied on hinder back with fuscous and very indistinctly speckled with pinkish buff; top of head and face washed with fuscous black, sides of head washed with smoke gray; eyelids buffy white; sides of body pinkish buff or cartridge buff; under parts and feet similar or slightly paler; tail above, similar to the back, but distal two-thirds mixed with blackish and tipped with pale cartridge buff; tail beneath, pinkish buff, bordered at distal end with blackish.

*Variation*.—Other specimens taken in June are considerably paler than the type, the general tone of upper parts varying from wood brown to drab, and some of the immature individuals are more conspicuously spotted.

*Measurements*.—Average of 11 adults from type locality: Total length, 250.4 (243–261); tail vertebrae, 70.5 (57–78), hind foot, 38.7 (38–40). *Skull*: Greatest length, 43.5 (42.2–44.5); palatilar length, 20.6 (20–21.5); zygomatic breadth, 26.4 (25.2–27.3); cranial breadth, 19.5 (19.1–20); interorbital breadth, 9.3 (8.8–9.8); postorbital constriction, 14 (13.3–14.7); length of nasals, 15.5 (14.5–16.5); maxillary tooth row, 8.7 (8.3–9).

*Remarks*.—The Perote ground squirrel—the largest member of the *spilosoma* group—is clearly related to *C. s. spilosoma* but apparently does not intergrade with it. Its range apparently is restricted to the high plains at the extreme eastern border of the Mexican tableland. As pointed out by Merriam, this species bears a general external resemblance to *C. richardsonii elegans*, but differs widely from it in skull characters and belongs in another subgenus.

*Specimens examined*.—Total number, 16, from type locality.

## POLIOCITELLUS, subgenus nov.

[Characters and description on p. 42]

## CITELLUS FRANKLINII (SABINE)

## FRANKLIN'S GROUND SQUIRREL

(Pl. 6)

*Arctomys franklinii* Sabine, Linn. Soc. London Trans. 13: 587, 1822.*Arctomys (Spermophilus) franklinii* Richardson, Fauna Boreali-Amer. 1: 168, 1829.*Spermophilus franklini* Lesson, Manual Mamm., p. 244, 1827.[*Citellus*] *franklini* Trouessart, Cat. Mamm., Sup., p. 342, 1904.

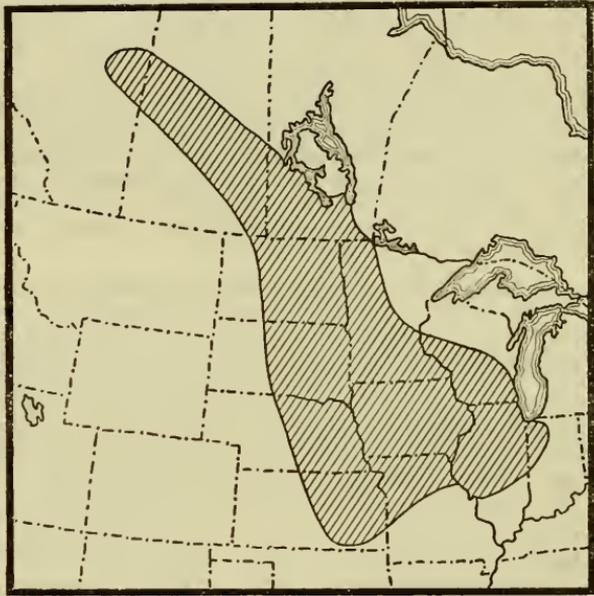
*Type*.—Collected at Carlton House, Saskatchewan, probably by John Richardson (Preble, 1908, p. 165); male, skin and skull, no. 61a, British Museum.

*Range*.—Great Plains region of southern Canada and the upper Mississippi and Missouri Valleys; north to Athabaska Landing, Alberta; east to Lake Winnipeg, Manitoba, southeastern Wisconsin, and northwestern Indiana; south to southeastern Kansas, central Missouri, and central Illinois; west to Edmonton, Alberta, the Missouri Valley in North Dakota and South Dakota, central Nebraska and central Kansas; introduced in Ocean County, N. J. (fig. 12). *Zonal range*: Transition and Upper Austral.

*External characters*.—About the size of *C. parryii plesius* but tail longer; ears larger, suborbicular.

*Cranial characters*.—Skull long and narrow, with flattened superior outline, quite unlike any member of the subgenus *Citellus*; somewhat resembling *C. beecheyi* but rostrum longer; brain case narrower and less inflated; temporal region more constricted; and anterior border of zygomatic notch reaching only to posterior border of *m*<sup>1</sup>.

*Color*.—*Summer pelage* (topotypes, July): Head grayish, the bases of the hairs fuscous black, tips grayish white. (The color tone of the head varies with the amount of wear, worn pelages being decidedly darker than fresh pelages because of the exposure of the dark bases of the hairs.) Dorsum tawny olive or clay color, more or less shaded with fuscous; sides pinkish buff or cinnamon buff mixed with grayish white; thighs pale smoke gray, shaded with pinkish buff and fuscous; front feet pinkish buff; hind feet grayish

FIGURE 12.—Distribution of *Citellus franklinii*.

white, shaded with tilleul buff; tail above and below, blackish mixed with tilleul buff, overlaid and bordered with creamy white; under parts pinkish buff or buffy white.

*Variation.*—Certain specimens in worn summer pelage are decidedly darker above than those in the fresh pelage described, the general tone of the upper parts being sayal brown or ochraceous fawny; in these the exposure of the fuscous bases of the hairs produces the effect of spotting. *Winter pelage* (North Dakota specimens in May): Similar to fresh summer pelage but paler, the tips of the hairs on upper parts pinkish buff, the sides paler and more whitish; feet paler and less buffy. Specimens taken in April (Nebraska) and May (Alberta), being apparently in winter pelage, are darker than those described above, the general tone of the upper parts being clay color.

*Measurements.*—Average of 6 adult males from Saskatchewan (type locality) and Alberta: Total length, 388.7 (381–397); tail vertebrae, 144.7 (136–153); hind foot, 55.1 (53–57.5); ear from notch, 10.5 (10–11). Average of 5 adult females from Saskatchewan (Wingard and Indian Head): Total length, 384.6 (363–401); tail vertebrae, 146.8 (133–156); hind foot, 52.8 (51–55); ear from notch, 10.5 (10–11). *Skull:* Average of 5 adult males from Saskatchewan and Alberta: Greatest length, 54.2 (53–54.6); palatilar length, 26.3 (25–27); zygomatic breadth, 31.4 (31–32.1); cranial breadth, 21.1 (20.9–21.3); interorbital breadth, 12.3 (12.1–12.7); postorbital constriction, 13.1 (12.8–13.4); length of nasals, 18.4 (17.6–18.8); maxillary tooth row, 10.3 (10.2–10.4). Average of 5 adult females from Saskatchewan (Wingard and Indian Head): Greatest length, 53.2 (52.1–55.1); palatilar length, 25.8 (25–27); zygomatic breadth, 30.6 (30.1–31.4); cranial breadth, 20.5 (20.2–20.7); interorbital breadth, 12 (11.4–12.5); postorbital constriction, 13.1 (13–13.4); length of nasals, 18.4 (17.8–19.6); maxillary tooth row, 10.4 (10.2–10.7).

*Remarks.*—Franklin's ground squirrel is a very distinct species, having no close relatives and although it exhibits considerable variation in color, these differences are individual and not correlated with geographical distribution. It was introduced into New Jersey at Tuckerton in May 1867, a single pair brought from Illinois having escaped from their cage and established themselves in the sandy fields. Since then they have spread northward as far as Manahawken and westward to Speedwell (Stone, 1908, p. 80).

*Specimens examined.*—Total number, 160, as follows:

Alberta: Edmonton, 1; Sturgeon River (25 miles north of Edmonton), 2.

Illinois: West Northfield (Cook County), 1.<sup>34</sup>

Indiana: Benton County, 1; Lake Village (Newton County), 6;<sup>35</sup> North Liberty (St. Joseph County), 3.<sup>36</sup>

Iowa: Ames, 2; Charles City, 1;<sup>37</sup> Clay County, 9;<sup>34</sup> Milford, 1;<sup>34</sup> Wall Lake, 3.<sup>37</sup>

Kansas: Manhattan, 1; Onaga, 1.

Manitoba: Carberry, 3; Manitoba House, 1; Winnipeg, 1.

Minnesota: Browns Valley, 4; Cass Lake, 2; Elk River, 10; Fort Snelling, 1;<sup>38</sup> Heron Lake, 2; Ortonville, 10.

Nebraska: Ames (Dodge County), 1; Columbus, 2; Kearney, 1; Niobrara, 1; Verdigris, 1.

New Jersey: Tuckerton, 5.

North Dakota: Blackmer (Richland County), 4; Devils Lake, 6; Fairmount, 14; Fargo, 1; Fish Lake (Benson County), 4; Grafton, 1; Grand Forks, 1; Harwood (Cass County), 3; Kathryn (Barnes County), 1; La Moure, 1;

<sup>34</sup> Univ. Michigan Mus. Zool.

<sup>35</sup> P. F. Hickie collection.

<sup>36</sup> Univ. of Notre Dame.

<sup>37</sup> Dayton Stoner collection.

<sup>38</sup> Field Mus. Nat. Hist.

Larimore, 2; Oakes, 3; Pembina, 5; Spring Lake (Rolette County), 1; Stump Lake, 2; Turtle Mountains, 2;<sup>34</sup> Walhalla, 2.

**Ontario:** Rainy River, 7.<sup>30</sup>

**Saskatchewan:** Carlton, 4; Indian Head, 3; Oxbow, 1; Prince Albert, 1;<sup>35</sup> Wingard, 5.

**South Dakota:** Flandreau, 1; Fort Sisseton (Marshall County), 2; Scotland, 1; Vermillion, 1.

**Wisconsin:** Delavan, 4.

### Subgenus OTOSPERMOPHILUS Brandt

[Characters on p. 43]

#### COLOR PATTERN

In the typical species and its near relatives the color of the upper parts is a mixture of various shades of buff, black, and white, the hinder back usually presenting a mottled appearance; some races have prominent whitish shoulder patches, others have solid black areas on the head or anterior back; the bases of the hairs are fuscous; the tail hairs are banded with black.

#### PELAGE AND MOLT

The pelage is full and soft when fresh, shorter and harsher when worn. There is but one molt annually, which may occur at any time from early in May to early in September, depending in part on the climate. Breeding females are likely to molt later than males.

#### KEY TO SPECIES AND SUBSPECIES

- a*.<sup>1</sup> Head black or brown.
- b*.<sup>1</sup> Shoulders and fore back solid black or brown.....*buckleyi* (p. 141).
- b*.<sup>2</sup> Shoulders and fore back mixed with whitish.
- c*.<sup>1</sup> Upper parts brownish or buffy.
- d*.<sup>1</sup> Size small (skull length less than 60 mm).....*atricapillus* (p. 161).
- d*.<sup>2</sup> Size large (skull length more than 60 mm).
- f*.<sup>1</sup> Head black.....*couchii* (p. 139).
- f*.<sup>2</sup> Head brown.....*rupestris* (p. 138).
- c*.<sup>2</sup> Upper parts blackish.....*variegatus* (p. 136).
- a*.<sup>2</sup> Head mixed with buffy.
- b*.<sup>1</sup> Nape and shoulders with a dark median area.
- c*.<sup>1</sup> Fore back with a blackish patch.....*douglasii* (p. 150).
- c*.<sup>2</sup> Fore back without a blackish patch.
- d*.<sup>1</sup> White shoulder patches indistinct.....*nesioticus* (p. 160).
- d*.<sup>2</sup> White shoulder patches distinct.
- c*.<sup>1</sup> Upper parts darker.
- f*.<sup>1</sup> Feet whitish.....*sierrae* (p. 153).
- f*.<sup>2</sup> Feet buffy.
- g*.<sup>1</sup> Under parts darker (more buffy).....*beccheyi* (p. 148).
- g*.<sup>2</sup> Under parts paler (more whitish).....*nudipes* (p. 158).
- c*.<sup>2</sup> Upper parts paler.
- f*.<sup>1</sup> Size larger (skull length, 55-62 mm).....*fisheri* (p. 154).
- f*.<sup>2</sup> Size smaller (skull length, 52-60 mm).....*parvulus* (p. 156).
- b*.<sup>2</sup> Nape and shoulders without dark median area.
- c*.<sup>1</sup> Upper parts blackish.
- d*.<sup>1</sup> Head more blackish.....*variegatus* (p. 136).
- d*.<sup>2</sup> Head more buffy.....*tularosac* (p. 145).
- c*.<sup>2</sup> Upper parts brownish or buffy.
- d*.<sup>1</sup> Size smaller (skull length of ♀ less than 57 mm).....*rupinarum* (p. 159).
- d*.<sup>2</sup> Size larger (skull length of ♀ more than 57 mm).
- f*.<sup>1</sup> Hinder back more tawny.....*ntah* (p. 146).
- f*.<sup>2</sup> Hinder back more buffy.....*grammurus* (p. 142).

<sup>34</sup> Univ. Michigan Mus. Zool.

<sup>35</sup> Field Mus. Nat. Hist.

<sup>36</sup> Royal Ontario Mus.

## CITELLUS VARIEGATUS (ERXLEBEN)

[Synonymy under subspecies]

*Specific characters.*—Size large; hind foot, 53–65 mm; tail, 174–263; skull length, 56–67.7. Skull somewhat resembling that of *C. parryi* but differing in the characters of the subgenus; dorsal profile nearly flat; brain case and interorbital region relatively broader; parietal ridges meeting at posterior end of cranium to form a slight crest; rostrum relatively broad, tapering gradually; postorbital processes stout, decurved; supraorbital borders of frontals slightly elevated; zygomata less widely expanded; audital bullae relatively long and narrow, the meatus tube very short; upper incisors stout, not prognathous; molariform teeth low-crowned (as described under subgeneric characters, p. 43).

*Color.*—Head varying from pinkish buff or pinkish cinnamon to seal brown and fuscous black; upper parts varying from grayish white mixed with cinnamon buff to snuff brown, mikado brown, bone brown, and dark blackish brown; in some races the head and fore back, in others the whole dorsal surface is blackish; the tail is mixed black or brown and buffy white.

## CITELLUS VARIEGATUS VARIEGATUS (ERXLEBEN)

MEXICAN ROCK SQUIRREL

(Pl. 7)

[*Sciurus*] *variegatus* Erxleben, Syst. Regni, Anim 1: 421, 1777.

*Sciurus buccatus* Lichtenstein, Abhandl. k. Akad. Wiss. Berlin, 1827 (1830), p. 117.

*Spermophilus macrourus* Bennett, Zool. Soc. London Proc. 1833: 41. ("West-Mexico"—in Zool. Society register.)

*Spermophilus variegatus* Nelson, Science (n. s.) 8: 898, 1898.

[*Citellus*] *variegatus* Elliot, Field Columb. Mus. Pub., Zool. Ser. 4: 148, 1904.

*Otospermophilus variegatus* Miller, U. S. Natl. Mus. Bull. 128: 181, 1924.

*Type.*—None designated; type locality fixed at Valley of Mexico near the City of Mexico (Nelson, 1898, p. 898).

*Range.*—Central Mexico, from southern Zacatecas and San Luis Potosi south to Michoacan and the Valley of Mexico; west to Colima, Jalisco, and Nayarit (fig. 13). *Zonal range:* Upper and Lower Sonoran.

*External characters.*—Size large; tail long (nearly half the total length); head blackish, more or less mixed with buff; general tone of upper parts gray, more or less heavily mixed with blackish; tail mixed black and white.

*Cranial characters.*—Skull of large size; zygomata heavy and rather widely expanded; interorbital region broad; postorbital processes heavy; nasals ending posteriorly on a line with ascending arms of premaxillae or slightly beyond.

*Color.*—*Winter pelage* (Valley of Mexico): Sides of nose pinkish buff or tilleul buff; front and sides of face brownish, mixed with buffy white; eyelids broadly margined with dull white; crown and occiput dark blackish brown; hairs on the dorsal surface fuscous or fuscous black at base, banded with dull white or pinkish buff, some tipped with blackish; feet drab gray, tinged with fuscous; thighs washed with cinnamon buff or ochraceous tawny; tail blackish, mixed with buffy white and cinnamon buff; under parts grayish white or cinnamon buff.

*Variation.*—The majority of the specimens of this race have more or less black on the head; some however, have the hairs on the head fuscous basally, tipped with pinkish buff; the amount of black showing on the dorsal surface varies considerably, some being only slightly darker than certain specimens of *C. v. grammurus*.

*Molt.*—The molting season covers a considerable part of the year; in a specimen from Nayarit, taken April 12, new pelage covers the head and anterior half of the back; one from Guanajuato, June 20, and one from Michoacan, July 14, have nearly completed the molt; several from San Luis Potosi, August 17, are badly worn and new pelage is coming in on the anterior upper parts; one from Guanajuato, November 7, had acquired a fresh pelage on the head and the posterior half of the body, leaving a worn area of old pelage on the shoulders and nape.

*Measurements.*—Average of 8 adult males from central Mexico (Federal District, Puebla, and Michoacan): Total length, 499 (470–520); tail vertebrae, 227.4 (197–249); hind foot, 62.7 (59–65); ear from notch (dry), 18.9 (18–20). Average of 7 adult females from same region: Total length, 479

(447–510); tail vertebrae, 222 (212–233); hind foot, 60 (57–64); ear from notch, 19.2 (19–19.5, two specimens only). *Skull:* Average of 9 adult males from central Mexico (Federal District, Puebla, Michoacan, Jalisco, San Luis Potosi, and Colima): Greatest length, 65.6 (64.1–67.7); palatilar length, 31.5 (29.8–33); zygomatic breadth, 40.5 (38.1–41.8); cranial breadth, 26.1 (25.5–26.6); interorbital breadth, 16.9 (15.5–18.1); postorbital constriction, 17.7 (16.7–18.8); length of nasals, 23.8 (22.4–24.5); maxillary tooth row, 13.4 (12.8–14). Average of 7 adult females from the same region: Greatest length, 62.1 (59–65.7); palatilar length, 29 (28.5–32.5); zygomatic breadth, 38.7 (36–42.4); cranial breadth, 25.5 (24.3–26.7); interorbital breadth, 15.7 (13.7–18.8); postorbital constriction, 17.9 (16.4–19.6); length of nasals, 21.8 (21–22.9); maxillary tooth row, 13.1 (12.7–13.7).

*Remarks.*—Nelson (1898, p. 898) has shown the pertinence of Erxleben's name *Sciurus variegatus* to the Mexican rock squirrel, and as suggested by him, this animal proves to be connected subspecifically with *C. v. couchii* and *C. v. grammurus*, as well as with *C. v. rupestris*.

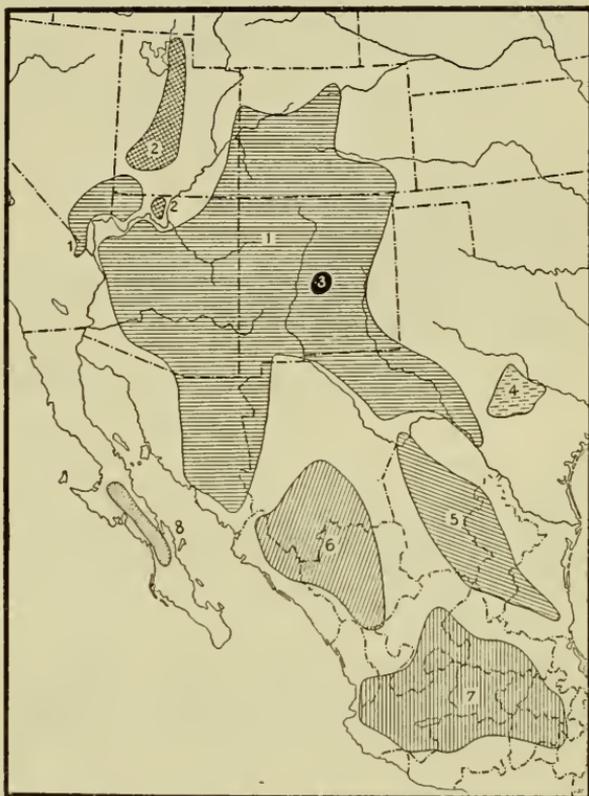


FIGURE 13.—Distribution of *Citellus atricapillus* and of the subspecies of *C. variegatus*: 1, *C. v. grammurus*; 2, *C. v. utah*; 3, *C. v. tularosae*; 4, *C. v. duckleyi*; 5, *C. v. couchii*; 6, *C. v. rupestris*; 7, *C. v. variegatus*; 8, *C. atricapillus*.

The subspecies is abundant over a large area in south-central Mexico. Specimens from Hacienda La Parada, Villar, and Rio Verde, in the State of San Luis Potosi, show approach to *couchii* in the darkening of the heads and paling of the backs; their skulls, however, agree well with those of *variegatus* and are distinctly larger than those of *couchii*.

*Specimens examined*.—Total number, 95, as follows:

**Colima:** Hacienda San Antonio (at base of Volcano of Colima), 3.

**Guanajuato:** Santa Rosa, 2; Silao, 1.

**Hidalgo:** Encarnacion, 2; Ixmiquilpan, 2; Tulancingo, 1; Zimapan, 1.

**Jalisco:** Ameca, 1; Atemajac, 9; Barranca Ibarra, 1; Chapala, 1; Etzatlan, 3; Guadalajara, 1; La Barca, 1; Lagos, 2; Ocotlan, 2; Plantinar, 1; Sierra Nevada de Colima, 1; Zacoalco, 1; Zapotlan, 6.

**Mexico:** Mount Popocatepetl, 1; Amecameca, 1; Tlalpam, 6.

**Michoacan:** Acambaro, 1; Los Reyes, 1; Mount Tancitaro, 2; Patzcuaro, 12; Querendaro, 1; Zamora, 2.

**Morelos:** Tetela del Volcan, 1.

**Nayarit:** Tepic, 1.

**Puebla:** San Martin, 1.

**Queretaro:** Tequisquiapan, 1.

**San Luis Potosi:** Ahualulco, 1; Hacienda La Parada (20 miles northwest of San Luis Potosi), 12; Jesus Maria, 1; Rio Verde, 2; Villar, 5.

**Zacatecas:** Berriozabal, 1.

#### CITELLUS VARIEGATUS RUPESTRIS ALLEN

##### BROWN-HEADED ROCK SQUIRREL

(Pls. 26, C; 31, C)

*Citellus (Otospermophilus) grammurus rupestris* Allen, Amer. Mus. Nat. Hist. Bull. 19: 595, Nov. 12, 1903.

[*Citellus variegatus*] *rupestris* Elliot, Field Columb. Mus. Pub., Zool. Ser. 4: 150, 1904.

*Otospermophilus grammurus rupestris* Miller, U. S. Natl. Mus. Bull. 128: 181, 1924.

*Type*.—Collected on Rio Sestin, northwestern Durango, Mexico, April 12, 1903, by J. H. Batty; female adult, skin and skull, no. 21231, Amer. Mus. Nat. Hist. (orig. no. 419).

*Range*.—Eastern and western slopes of the Sierra Madre and adjacent plains on eastern side from southern Durango north to southern Chihuahua; east to Chihuahua City and Santa Rosalia; west to Sierra de Choix, Sinaloa (fig. 13). *Zonal range*: Upper and Lower Sonoran and Transition.

*External characters*.—Similar to *C. v. variegatus*, but upper parts decidedly paler and brownish or buffy rather than blackish in tone; head brown instead of black; under parts more buffy; similar also to *C. v. couchii* but paler and less blackish in general tone, and head brown instead of black.

*Cranial characters*.—Skull similar to that of *variegatus* and *couchii*, but averaging longer and relatively narrower, with longer nasals.

*Color*.—(Topotypes in April): Top and sides of head, nape, and ears, bone brown; front and sides of face more or less washed with buffy white; eye ring whitish or buffy; hairs on dorsal area fuscous at base, shading to bone brown on the nape and to hair brown on the rump and sides; subterminal band of dorsal hairs varying from buffy white to cinnamon buff; tips of hairs brown or fuscous; tail above and below, buffy white, mixed with fuscous and sometimes also with

light cinnamon buff; feet tilleul buff or pinkish buff, the legs washed with cinnamon buff or ochraceous tawny; under parts varying from cinnamon buff to buffy white.

*Variation.*—The topotype series shows a large amount of variation in color in the upper parts, apparently due in part to fading and wear of the pelage. The general tone of the dorsal surface varies from bone brown to cartridge buff or cinnamon buff; in a specimen from near Guadalupe y Calvo, Chihuahua, and one from Sierra de Choix, Sinaloa, the brown of the head and nape extends to or beyond the middle of the back.

*Molt.*—Many of the specimens from Rio Sestin, taken in April, are badly worn; two (Apr. 12, 17) show new pelage coming in on the anterior half of the back.

*Measurements.*—Average of 9 adult males from type locality (Allen, 1903b, p. 596): Total length, 503 (451–540); tail vertebrae, 233 (210–248); hind foot (without claws), 56.7 (55.5–57); ear from notch (dry), 26.3 (25–28). Fourteen adult females: Total length, 499 (463–521); tail vertebrae, 227 (203–241); hind foot, 56 (54–60); ear, 26.3 (25–29). The hind foot, as measured dry from 7 of these specimens (5 males; 2 females) averages 61.1 (59–65). One adult male from Durango City: 510; 238; 60; one adult female from Guazamota, Durango: 548; 263; 60. *Skull.* Average of 7 adults (2 males, 5 females) from type locality: Greatest length, 64 (61.2–67); palatilar length, 30.6 (29–32.5); zygomatic breadth, 38.8 (37.5–40.9); cranial breadth, 25.3 (24.6–25.9); interorbital breadth, 15.2 (14.6–16); postorbital constriction, 17.2 (15.5–18.1); length of nasals, 23.3 (22.8–23.7); maxillary tooth row, 12.8 (11.9–13.3).

*Remarks.*—This is a well-marked race, occupying an extensive area in western Mexico. Intergradation with *C. v. grammurus* is shown by series from Chihuahua and Santa Rosalia; most of the specimens from those localities have the head partly brownish black and agree generally in color with *rupestris*, though two adults from Chihuahua and three young from Santa Rosalia are scarcely different from typical specimens of *grammurus*. The skulls are likewise intermediate in characters, resembling those of *rupestris* in shape, though smaller, and having larger molars than *grammurus*.

A single specimen from Guazamota, southern Durango, which agrees in color with *rupestris*, has a skull agreeing in size and shape with skulls of *variegatus*.

No intergrades of this race with *couchii* have been seen, but quite likely such may be found when collections are secured from the territory intervening between their known ranges.

*Specimens examined*—Total number, 58, as follows:

**Chihuahua:** Chihuahua, 9; Samachique (Sierra Tarahumara), 4;<sup>41</sup> Santa Rosalia, 7; Sierra Madre, near Guadalupe y Calvo, 4.  
**Durango:** Coyotes, 3;<sup>41</sup> Durango, 1; Guazamota, 1; Rancho Bailon (east of Sestin Valley), 10;<sup>40</sup> Rio Sestin, 17.  
**Sinaloa:** Sierra de Choix (50 miles northeast of Choix), 1.  
**Sonora:** Oposura, 1.

#### CITELLUS VARIEGATUS COUCHII (BAIRD)

##### COUCH'S ROCK SQUIRREL

*Spermophilus couchii* Baird, Acad. Nat. Sci. Phila. Proc. 1855: 332.

*S[permophilus] grammurus couchii* Allen, Amer. Mus. Nat. Hist. Bull. 8: 6S, 1896.

<sup>40</sup> Amer. Mus. Nat. Hist.

<sup>41</sup> Field Mus. Nat. Hist.

*Citellus variegatus couchi* Bailey, North Amer. Fauna 25: 83, 1905.

*Otospermophilus grammurus couchii* Mearns, U. S. Natl. Mus. Bull. 56: 324, 1907.

*Type*.—Collected at Santa Catarina (a few miles west of Monterey), Nuevo Leon, Mexico, April 1853, by Lt. D. N. Couch; skin and skull, no.  $\frac{338}{1255}$  U. S. Natl. Mus.

*Range*.—Northeastern Mexico, from southern Coahuila and Nuevo Leon north to the Chisos Mountains, Tex. (fig. 13). *Zonal range*: Upper and Lower Sonoran.

*External characters*.—Similar to *C. v. variegatus* but smaller; dorsum paler and more brownish or buffy (less blackish); feet paler; top of head always black or dark brown. Similar to *C. v. rupestris* but head and upper parts darker and more blackish (less brownish or buffy); under parts darker.

*Cranial characters*.—Skull similar to that of *variegatus* but averaging smaller, especially in the males.

*Color*.—(Specimens in normal phase from Saltillo, Coahuila): Front and sides of face grayish, with a tinge of brown; crown, occiput, sides of head, and ears, dark seal brown or black; eyelids broadly margined above and below with grayish white; hairs on dorsal area fuscous at base, tipped with white on nape and shoulders, and with pinkish buff on middle and hinder back; middle of back often showing a brownish patch.

*Variation*.—Of eight specimens collected at the type locality, only one is of the normal color, the other seven being melanistic; in these the head and upper parts are dark blackish brown, shading on hinder back to dark seal brown; feet and under parts seal brown; tail seal brown, shaded with blackish brown. In faded pelage these melanistic specimens show patches of cinnamon or walnut brown on the back.

*Molt*.—Specimens taken at the type locality on April 13 show the molt in progress, the greater part of the body having acquired a new coat, while patches of the old faded pelage still remain on the rump and hinder back.

*Measurements*.—Average of 15 adults (9 males, 6 females) from Santa Catarina and Saltillo, Mexico: Total length, 466 (430–493); tail vertebrae, 204 (174–235); hind foot, 60.9 (58–64). *Skull*: Average of 16 adults (8 males, 8 females) from the same localities: Greatest length, 60.1 (57–63.6); palatilar length, 28.6 (26–30.5); zygomatic breadth, 37.4 (34–39.3); cranial breadth, 24.7 (23.5–25.5); interorbital breadth, 15 (12.3–17.4); postorbital constriction, 17 (15.9–18.1); length of nasals, 20.4 (18.5–21.9); maxillary tooth row, 12.4 (11.8–13).

*Remarks*.—This race is closely related to *variegatus* and furnishes a link connecting the latter with *C. v. grammurus*. In the typical form, as found in Coahuila and Nuevo Leon, it is distinguished by the combination of a blackish or brownish head, sharply contrasted with a rather pale-colored back.

Writing of these squirrels as seen at Santa Catarina, Nuevo Leon, Nelson (ms. notes) says:

Although the bare sun-baked limestone slopes of the canyons where they live are practically devoid of any cover formed by vegetation and the rocks are pale gray, so that these animals live in a glare of intense light, yet at least 80 percent of those seen were melanistic. These black animals sunning themselves on the pale-colored rocks were very conspicuous.

At Saltillo, Coahuila, where 12 specimens were taken, no black ones were seen, but in the canyons of the Sierra Guadalupe more than half of the animals seen were in the melanistic phase.

Four specimens from the Chisos Mountains, Tex., are best referred to this race, although two of them show apparent intergradation with *grammurus* in having the heads partly gray rather than solid black; one of the black-headed ones has the black color reaching to the middle of the back, as in *C. v. buckleyi*. The skulls agree closely with those of typical *C. v. couchii*. One specimen from Boquillas, Tex., in the melanistic phase is wholly seal brown.

*Specimens examined*.—Total number, 29, as follows:

Coahuila: Carneros, 1; Saltillo, 12; Sierra Encarnacion, 1; Sierra Guadalupe, 1.  
Nuevo Leon: Santa Catarina, 8.

Tamaulipas: Victoria, 1.

Texas: Boquillas, 1; Chisos Mountains, 4.

### CITELLUS VARIEGATUS BUCKLEYI (SLACK)

#### BLACK-BACKED ROCK SQUIRREL

(Pl. 7)

*Spermophilus buckleyi* Slack, Acad. Nat. Sci. Phila. Proc. 1861: 314.

*Spermophilus grammurus buckleyi* Allen, Amer. Mus. Nat. Hist. Bull. 8: 67, 1896.

*Citellus variegatus buckleyi* Bailey, North Amer. Fauna 25: 84, 1905.

*Otospermophilus grammurus buckleyi* Mearns, U. S. Natl. Mus. Bull. 56: 323, 1907.

*Type*.—Collected at Packsaddle Mountain, Llano County, Tex., about 1861 by S. R. Buckley; entered as no. 998, Museum Acad. Nat. Sci., Philadelphia, but now reported missing.

*Range*.—South-central Texas, "in the rough and semiarid mesquite country along the eastern slope of the southern arm of the Staked Plains" (Bailey, 1905, p. 84), from the upper Nueces River (Rock-springs) east nearly to San Antonio and Austin; north to San Saba River (fig. 13). *Zonal range*: Upper and Lower Sonoran.

*External characters*.—Similar to *C. v. couchii* but upper parts more extensively blackish.

*Cranial characters*.—Skull similar to that of *couchii*, but averaging larger, with longer nasals; shorter and relatively broader than that of *C. v. rupestris*, with smaller molariform teeth.

*Color*.—Head and anterior upper parts, to or beyond the middle of the back, black or dark seal brown, sometimes sparingly sprinkled with whitish hairs, especially along the sides; hinder back and sides grizzled iron gray, the bases of the hairs fuscous, tipped with white or pale buff; feet drab gray, more or less washed with fuscous; tail fuscous black, variegated and tipped with pale buffy white; under parts fuscous, more or less shaded with white and pinkish buff.

*Variation*.—Wholly black individuals of this race have not been seen; one from Japonica, Tex., however, has the black extending along the back from nose to root of tail with a considerable mixture of whitish hairs along the sides; a juvenile specimen from Llano has the crown black, but the rest of the body grizzled gray.

*Molt*.—Two specimens from Llano, taken May 12 and 13, show the molt in progress, fresh pelage covering the anterior part of the body to beyond the middle of the back. One from Japonica, taken July 7, shows fresh pelage covering nearly the whole body except a small strip across the middle of the back, where the old faded pelage still remains.

*Measurements.*—Average of 11 adults (5 males, 6 females) from central Texas (Llano, Japonica, Rocksprings, Camp Verde): Total length, 500 (470–525); tail vertebrae, 226 (210–252); hind foot, 62 (60–65); ear from notch (dry), 19.7 (19–22). *Skull:* Average of 15 adults (6 males, 9 females), from Mason and Llano, Tex.: Greatest length, 62.9 (60.6–64.8); palatilar length, 29.8 (28.5–31); zygomatic breadth, 38.3 (36.4–40.2); cranial breadth, 25.1 (24.7–26.3); interorbital breadth, 14.5 (13.7–15.9); postorbital constriction, 17.7 (16.5–18.4); length of nasals, 23.6 (21.5–24.8); maxillary tooth row, 12.2 (11.5–13).

*Remarks.*—This race occupies a small area at the eastern edge of the range of the species in Texas; it has developed large size and extensively blackish coloration. Apparently it intergrades with *C. v. grammurus* in the region between the mouths of Pecos and Devils Rivers, the specimens from that section being referred to *grammurus*. Bailey (1905, p. 84), however, states:

Apparently the open divide between the headwaters of the Nueces and the headwaters of the streams flowing into the Rio Grande separates the ranges of *buckleyi* and *couchi* [here referred to *grammurus*] with a neutral strip in which neither occurs.

He adds (ms. notes):

I see no way to account for the peculiar coloration of this squirrel on the grounds of protective coloration. There are few if any dark colored rocks or burnt logs and trees [in its habitat]. The rocks are mainly light colored granite.

*Specimens examined.*—Total number, 42, as follows:

Texas: Austin (16 miles northwest), 1; Bull Creek (Travis County), 1; Camp Verde (7 miles west, Kerr County), 3; Fort Mason, 1; Ingram (Kerr County), 3;<sup>42</sup> Japonica (Kerr County), 1; Llano, 11; Mason, 18; Rocksprings, 3.

#### CITELLUS VARIEGATUS GRAMMURUS (SAY)

##### SAY'S ROCK SQUIRREL

*S[ciurus] grammurus* Say, Long's Exped. Rocky Mountains 2: 72, 1823.

[*Spermophilus grammurus*] var. *grammurus* Allen, Boston Soc. Nat. Hist. Proc. 16: 293, 1874.

*Anisonyx (Otospermophilus) grammurus* Allen, Amer. Mus. Nat. Hist. Bull. 7: 237, 1895.

[*Citellus variegatus] grammurus* Elliot, Field Columb. Mus. Pub., Zool. Ser. 4: 149, 1904.

*Otospermophilus grammurus* Mearns, U. S. Natl. Mus. Bull. 56: 315, 1907.

*Citellus grammurus grammurus* Miller, U. S. Natl. Mus. Bull. 79: 208, 1912.

*Citellus variegatus juglans* Bailey, Biol. Soc. Wash. Proc. 26: 131, 1913 (Glenwood, N. Mex.).

*Otospermophilus grammurus grammurus* Miller, U. S. Natl. Mus. Bull. 128: 180, 1924.

*Type.*—None designated; specimen on which Say's description was based was taken on Purgatory River, near mouth of Chacuaco Creek, Las Animas County, Colo. (Cary 1911, p. 87).

*Range.*—Mountain valleys and foothills in Colorado, New Mexico, Arizona, southeastern and southwestern Utah, southern Nevada, northwestern Chihuahua, and eastern Sonora; north to eastern Larimer County, Colo.; east to Baca County, Colo.; south to southern Texas (Eagle Pass), and southern Sonora; west to the Providence Mountains, Calif., and Charleston Mountains, Nev. (fig. 13). *Zonal*

<sup>42</sup> Cleveland Mus. Nat. Hist.

range: Upper Sonoran and Transition (4,200–8,500 feet in New Mexico).

*External characters.*—Similar to *C. v. couchii* but much paler, and head without any black.

*Cranial characters.*—Skull very similar to that of *couchii* but averaging slightly shorter, though of the same breadth; nasals longer, projecting slightly beyond the posterior ends of the premaxillae; molariform teeth smaller.

*Color.*—(April specimen in unworn pelage, 18 miles south of La Junta, Colo.): Head and occiput pinkish buff, faintly shaded with fuscous; sides of nose cartridge buff; eye ring white; fore part of back, shoulders, and sides grayish white, slightly mixed with brownish; hinder part of back and rump cinnamon buff, moderately varied with clove brown; bases of hairs on dorsal area clove brown; ears hair brown, shaded with pinkish buff; front legs buffy white; hind legs cinnamon buff; fore and hind feet cartridge buff; tail mixed pinkish buff and bone brown, edged with grayish white; under parts buffy white, shaded with pinkish buff.

*Variation.*—September specimens from Bear Canyon, N. Mex., (about 12 miles northeast of Raton) and others from various parts of the range of the subspecies are considerably darker than the April specimens described above; the middle and hinder back pinkish cinnamon, heavily washed with brown (the general tone about cinnamon brown); head pinkish cinnamon more or less shaded with brown; sides of nose pinkish buff; ears clove brown outside, wood brown inside; feet pinkish buff or cinnamon buff; tail mixed black and buffy white; edged with grayish white. Occasional specimens (Fort Huachuca and Graham Mountains, Ariz.) have the back clear grayish, with only a very slight wash of buff.

*Molt.*—There is normally but one molt annually, in July or August. Two specimens (male and female) taken at San Pedro, N. Mex., July 5 and 6, show new pelage covering the anterior half of the body, the posterior half being badly worn. An adult female from Big Sandy Creek, Ariz., July 21, shows a similar progress of the molt. An adult male from Sierra Grande, N. Mex., August 19, is molting irregularly on the dorsal surface. An adult female from Red Lake, Ariz., September 7, is badly worn on the anterior half of the body and has the posterior portion covered with a fresh, full pelage.

As the season advances the pelage usually becomes paler and more grayish, due apparently to wearing off of the buffy tips to the hairs of the dorsal area.

*Measurements.*—Average of 11 adults (3 males, 8 females) from southeastern Colorado (La Junta, Trinidad, Canon City): Total length, 467.7 (434–510); tail vertebrae, 210.3 (198–235); hind foot, 57 (53–60); ear from notch (dry), 17 (15–19); average of 10 adults (4 males, 6 females) from southeastern Arizona (Fort Huachuca, Oracle, Santa Catalina Mountains): 477; 204; 58; 19.5. *Skull:* Average of 6 adult males from northeastern New Mexico (Folsom, Chico Springs, Sierra Grande) and Trinidad, Colo.: Greatest length, 60.9 (58.8–63.5); palatilar length, 29.3 (28.5–30); zygomatic breadth, 37.9 (36.4–39.1); cranial breadth, 25 (24.1–25.7); interorbital breadth, 14.8 (13.5–15.8); postorbital constriction, 17.6 (16.8–18.6); length of nasals, 21.9 (20.6–23); maxillary tooth row, 11.7 (11.3–12). Average of 10 adult females from southeastern Colorado (Trinidad, La Junta, Canon City) and northeastern New Mexico (Clayton, Bear Canyon): Greatest length, 59.7 (57.8–62.7); palatilar length, 28.5 (26.8–29.7); zygomatic breadth, 36.6 (34–38.9); cranial breadth, 24.9 (24.1–25.6); interorbital breadth, 14.7 (13.5–15.6); postorbital constriction, 17.4 (16.2–18.2); length of

nasals, 21.1 (20–22.3); maxillary tooth row, 11.8 (11.3–12.3). Average of 12 adult females from Fort Huachuca, Ariz.: 60.5; 29.2; 37.1; 25.3; 14.8; 18; 21.8; 11.8.

*Remarks.*—Say's rock squirrel has a very wide range and is subject to great individual and seasonal variation. No appreciable departure from the typical coloration is found in the large series examined from New Mexico and Arizona, including the form "*juglans*" named by Bailey from Glenwood, N. Mex.

A series of 10 specimens from the Davis Mountains, Tex., shows approach to *couchii* in the darkening of the heads of about half of the series; only one individual, however, has a wholly black head. The skulls average somewhat larger than those of either *grammurus* or *couchii*, being in fact, about the size of those of *C. v. buckleyi*.

A series of 15 specimens from the Rio Grande, between the Pecos River and Devils River, shows intergradation with *buckleyi* in partial darkening of the heads and shoulders of 5 individuals, the majority being almost typical of *grammurus*. Skulls of two of the specimens are larger even than those of *buckleyi*, while those of three other adults are typical of *grammurus*.

Specimens from Colonia Garcia, Chihuahua, and from numerous localities in Sonora as far south as Camoa, on the Rio Mayo, are only slightly darker than typical *grammurus*. One from Oposura and one from Ortiz, however, have considerable black on the nape and shoulders, thus showing approach to *C. v. rupestris*; the skulls of all of these from Chihuahua and Sonora agree closely with typical *grammurus* and do not approach *rupestris* in any characters.

This race intergrades with the subspecies *utah* in southwestern and probably in eastern Utah; the few specimens examined from western Colorado appear to be typical *grammurus*.

There is no indication that this species intergrades with *beecheyi*, specimens from the Providence Mountains, Calif., being typical *grammurus*.

*Specimens examined.*—Total number, 437, as follows:

Arizona: Anderson Mesa (Coconino County), 1; Apache (Cochise County), 2; Apache Maid Mountain (Coconino County), 2; Baker Butte (Coconino County), 2; Bates Well (20 miles south of Ajo, Pima County), 1; Beale Spring (near Kingman, Mohave County), 1; Big Sandy Creek (near Owens, Mohave County), 2; Bill Williams Mountain, 1; Bisbee, 1; Black River (5 miles above mouth of White River), 1; Blue River (Casper Ranch, Greenlee County), 3; Calabasas (Santa Cruz County), 4; Chiricahua Ranch (San Carlos Indian Reservation, Graham County), 1; Chiricahua Mountains, 2; Crown King (Yavapai County), 1; Congress Junction (Yavapai County), 1; Camp Verde (Yavapai County), 2; Dos Cabezos (Cochise County), 1; Fish Creek (Tonto National Forest, Maricopa County), 1; Fort Bowie (Cochise County), 2; Fort Grant (Graham County), 3; Fort Huachuca, 30; Fort Lowell, 1; Fort Whipple (Yavapai County), 1; Galiuro Mountains (Graham County), 1; Graham Mountains, 12; Grand Canyon (Coconino Plateau), 8; Huachuca Mountains, 12; Hualpai Mountains, 9; Keams Canyon (Navajo County), 1; Kingman, 1;<sup>43</sup> Kirkland (Yavapai County), 1; La Osa (Pima County), 1; Mayer (Yavapai County), 2; Mineral Park (Mohave County), 2; Montezuma Well (near Camp Verde, Yavapai County), 4; Mowry (Patagonia Mountains), 1; Nantan Plateau (San Carlos Indian Reservation), 3; Nogales, 2; Oatman, 1;<sup>44</sup> Oracle (Pinal County), 15; Oak Creek (15 miles southwest of Flagstaff), 2; Patagonia Mountains, 5; Payson (Gila County), 1; Phantom Ranch (Grand Canyon), 2; Pine Spring (8 miles north, Hualpai

<sup>43</sup> Univ. Michigan Mus. Zool.

<sup>44</sup> Cleveland Mus. Nat. Hist.

Indian Reservation), 1; Portal (Cochise County), 2; Prescott, 3; Prieto Plateau (east fork Eagle Creek, Greenlee County), 1; Red Lake (Cocouino County), 2; Rice (Gila County), 1; Roosevelt (Gila County), 2; San Bernardino Ranch (Mexican boundary), 2; San Francisco Mountain, 3; Santa Catalina Mountains, 2; Santa Cruz River (near Monument 118), 2; Santa Rita Mountains, 3; Sierra Ancha Mountains, 2; Simmons (Yavapai County), 1; Springerville, 2; Trumbull Mountains (Mohave County), 5; Tubac, 1; Tucson Mountains, 1; Vicksburg (Yuma County), 1; Warsaw Mills (Pajaritos Mountains, near Monument 132), 4; White-river (10 miles north, Navajo County), 1.

California: Providence Mountains, 10.

Chihuahua: Colonia Garcia, 5; San Luis Mountains, 4.

Colorado: Ashbaugh's Ranch, Montezuma County, 1; Boulder, 2; Buena Vista, 1; Canon City, 6; Chaffee County, 2;<sup>43</sup> Grand Junction, 1; La Junta (18 miles south), 3; La Veta, 1;<sup>43</sup> Lyons, 1; Pinewood (Larimer County), 1; Plateau Creek (12 miles east of Tunnel, Mesa County), 1; Rifle, 1; Trinidad, 7.

Nevada: Cedar Basin (Clark County), 4;<sup>45</sup> Charleston Mountains, 11;<sup>45</sup> Sheep Mountains (Clark County), 1.<sup>45</sup>

New Mexico: Animas Mountains, 2; Apache (Grant County), 3; Arroyo Seco (Taos County), 1; Bear Canyon (5 miles northeast of Bell, Colfax County), 3; Burro Mountains (Grant County), 3; Capitan Mountains, 16; Carlsbad, 2; Carlsbad Cave, 1; Carrizozo (14 miles north), 1;<sup>43</sup> Chico (Colfax County), 1; Cieneguilla (10 miles southwest of Taos), 4; Clayton, 3; Cloverdale, 1; Copperton (south of Mt. Sedgwick, Valencia County), 1; Florida Mountains (Luna County), 2; Folsom, 1; Fort Wingate (McKinley County), 1; Gallup, 1; Garfield (Doua Ana County), 1; Gila (Grant County), 1; Gila National Forest (east fork Gila River), 1; Glenwood (Catron County), 1; Grant (Valencia County), 3; Guadalupe Mountains, 1; Hachita, 3; Highrolls (Otero County), 4;<sup>43</sup> Hondo Canyon (Taos County), 1; Hondo River (White Mountains, Lincoln County), 1; Jicarilla Mountains, 3; Lincoln, 2; Luna (Catron County), 1; Magdalena Mountains, 2; Manzano Mountains, 3; Mescalero, 2;<sup>46</sup> Mimbres Mountains (head of Rio Mimbres), 1; Mosquero (Harding County), 2;<sup>44</sup> Pecos (San Miguel County), 1; Red River (8,200 feet altitude, Taos County), 1; Red-rock (Grant County), 1; Riley (Socorro County), 2; Rinconada (Rio Arriba County), 2; Rio Puerco (Valencia County), 1; Ruidoso (Lincoln County), 1; San Luis Mountains, 6; San Pedro (Santa Fe County), 3; Santa Rosa, 4; San Mateo Mountains (Socorro County), 2; San Mateo Mountains (Valencia County), 1; Sierra Grande, 1; Sweetwater (15 miles southwest of Springer), 2; Tres Piedras (Taos County), 1; Tularosa, 3; Zuni Mountains (Valencia County), 2.

Sonora: Bacerae (15 miles east), 1; Camoa, 1; Cerro Blanco, 3;<sup>47</sup> Guadalupe Canyon (Monument 73, Mexican boundary line), 2; Hermosillo, 3; Magdalena, 1; Nogales (and 32 miles south), 8; Ortiz, 1; Pilaes, 1; Providentia Mines, 4;<sup>47</sup> San Jose Mountain (8 miles south of Monument 93, Mexican boundary line), 3; Santa Cruz, 1.

Texas: Castle Mountains (Crockett County), 1; Comstock (and 40 miles northwest), 2; Davis Mountains, 11; Devils River, 6; El Paso, 1; Fort Davis, 2; Guadalupe Mountains, 2; Langtry, 1; Painted Cave (near mouth of Pecos River), 4; Pecos High Bridge, 1.

Utah: Beaverdam Mountains, 1; Pine Valley (Washington County), 2; Santa Clara, 2.

#### CITELLUS VARIEGATUS TULAROSAE BENSON

##### MALPAIS ROCK SQUIRREL

*Citellus grammurus tularosae* Benson, Calif. Univ. Pubs., Zool. Ser. 38: 336, Apr. 14, 1932.

*Otospermophilus grammurus tularosae* Bradt, Jour. Mammal. 13: 324, 1932.

*Type*.—Collected at French's Ranch, 5,400 feet altitude, 12 miles northwest of Carrizozo, Lincoln County, N. Mex., October 28, 1931,

<sup>43</sup> Univ. Michigan Mus. Zool.

<sup>44</sup> Cleveland Mus. Nat. Hist.

<sup>45</sup> D. R. Dickey collection (California Inst. Technology).

<sup>46</sup> New Mexico State College.

<sup>47</sup> Field Columbian Mus.

by Seth B. Benson; male adult, skin and skull, no. 50935, Mus. Vert. Zool. (orig. no. 1603).

*Range*.—"Lava beds of the Tularosa Basin in Lincoln and Otero Counties, New Mexico" (Benson) (fig. 13). *Zonal range*: Lower Sonoran.

*External characters*.—Very similar in color to typical *C. v. variegatus*, but head never black and hinder back more tawny; similar in size to *C. v. grammurus* but coloration distinctly darker (more blackish), due largely to the darker bases of the hairs on both dorsal and ventral surfaces; hinder back darker tawny; hind feet slightly darker.

*Cranial characters*.—Skull similar to that of *grammurus* (only one adult skull examined; extent of variation not known).

*Color*.—Winter pelage (October): Head grizzled with fuscous or black and light buff; eye ring white; ears blackish externally, edged with buff, cinnamon buff on inner surface; hairs on fore back fuscous black basally, tipped with white; hairs on hinder back dark fuscous basally, tipped with sayal brown and light buff; front feet pinkish buff, hind feet light pinkish cinnamon, all more or less grizzled with blackish; tail mixed black and grayish white; under parts grayish white or pinkish buff, the bases of the hairs dark fuscous.

*Measurements*.—*Adult male* (type): Total length, 488; tail vertebrae, 206; hind foot, 60; ear from notch (dry), 18. *Subadult female*: 437; 172; 53; 17. *Skull*: Adult male (type) and subadult female: Greatest length, 63, 57.5; palatal length, 30, 27; zygomatic breadth, 38.6, 34.7; cranial breadth, 25.8, 25.1; interorbital breadth, 15.5, 14.7; postorbital constriction, 18.3, 17.8; length of nasals, 23, 20.9; maxillary tooth row, 12.1, 11.8.

*Remarks*.—The Malpais rock squirrel, although occupying a very limited area in south-central New Mexico, and entirely surrounded by another wide-ranging race—*grammurus*—is apparently a well-marked form. It appears to be confined exclusively to the beds of dark-colored lava rock where this and other dark forms of rodents have developed.

*Specimens examined*.—Total number, 4, as follows:

New Mexico: French's Ranch, 12 miles northwest of Carrizozo, 3;<sup>48</sup> Malpais Lava Beds (near Carrizozo), 1.<sup>48</sup>

#### CITELLUS VARIEGATUS UTAH MERRIAM

##### UTAH ROCK SQUIRREL

*Citellus grammurus utah* Merriam, Biol. Soc. Wash. Proc. 16: 77, May 29, 1903.  
*Citellus variegatus utah* Elliot, Field Columb. Mus. Pub. Zool. Ser. 6: 115, 1905.  
*Otospermophilus grammurus utah* Miller, U. S. Natl. Mus. Bull. 128: 181, 1924.

*Type*.—Collected at foot of Wasatch Mountains, near Ogden, Utah, October 10, 1888, by Vernon Bailey; female adult, skin and skull, no. 186468, U. S. Natl. Mus. (Merriam collection, no. ) (orig. no. 291).

*Range*.—Central Utah, from the Wasatch Range south to the Beaver Mountains; also the Kaibab Plateau, Ariz. (limits of range imperfectly known) (fig. 13). *Zonal range*: Transition and Upper Sonoran.

<sup>48</sup> Mus. Vert. Zool.

*External characters.*—Similar to *C. v. grammurus*, but head and posterior back darker (more tawny), especially in unworn winter pelage.

*Cranial characters.*—Skull similar to that of *grammurus*, but averaging smaller.

*Color.*—*Winter pelage* (October): Head mixed pinkish buff and fuscous; a broad buffy white eye ring; shoulders and fore back grayish white, the bases of the hairs fuscous; hinder back snuff brown or mikado brown, sparingly tipped with light buff; lower sides grayish white; feet pinkish buff or grayish buff; tail mixed pale buff and fuscous black; under parts buffy white or pale pinkish buff.

*Molt.*—An adult female (nursing) taken at Nephi, Utah, July 5, is in worn winter pelage and shows new pelage coming in on the head and nape.

*Measurements.*—Average of 7 adult males from Utah (Ogden, Salt Lake City, Provo): Total length, 467 (454–495); tail vertebrae, 198 (185–210); hind foot, 60.5 (59–63); ear from notch (dry), 19.5 (18.5–21). Average of 5 adult females from Utah (Ogden, Provo, Salt Lake City, Marysvale): Total length, 438 (425–460); tail vertebrae, 189 (180–199); hind foot, 58.8 (56–61); ear from notch (dry), 18.7 (18–19). *Skull*: Average of 4 adult males from Utah (Ogden, Provo, Salt Lake City): Greatest length, 60.3 (57.5–63); palatilar length, 29.2 (28–30.5); zygomatic breadth, 36.9 (35.5–38); cranial breadth, 25.3 (24.8–25.8); interorbital breadth, 14.7 (14.2–15.2); postorbital constriction, 17.5 (17.1–18.3); length of nasals, 21.1 (19.8–22.4); maxillary tooth row, 11.5 (11.4–12). Average of 6 adult females from same localities: Greatest length, 57.9 (56–59.5); palatilar length, 27.7 (27–28.5); zygomatic breadth, 35.6 (34.6–36.8); cranial breadth, 24.1 (23.5–24.6); interorbital breadth, 13.5 (13.2–14.3); postorbital constriction, 16.9 (16–17.5); length of nasals, 20.6 (18.9–21.9); maxillary tooth row, 11.3 (10.7–11.6).

*Remarks.*—The Utah rock squirrel appears to be a recognizable race, but it is difficult to define the limits of its range. Upon comparison of typical specimens in unworn winter pelage with a similar series of *grammurus* from southeastern Colorado—the type region—marked differences in color are noticeable. However, throughout the wide range of *grammurus* in New Mexico and Arizona many individual specimens are found that agree very closely in color with specimens of *utah*. But nowhere in northern Utah do we find specimens to match the pale grayish or cinnamon buff type occurring in Colorado, New Mexico, and southeastern Arizona.

Two specimens from the Kaibab Plateau, Ariz., appear to be referable to *utah*, but whether this race has a continuous range from the Beaver Mountains south to the Kaibab is not known; *grammurus* occurs in practically typical form in extreme southwestern Utah and southern Nevada.

*Specimens examined.*—Total number, 34, as follows:

Arizona: Big Spring (Kaibab Plateau), 1; Kaibab Forest, 1.<sup>40</sup>

Utah: Beaver, 1; Cedar Fort (Utah County), 1; Florence Canyon, 35 miles north of Green River (city), 6;<sup>50</sup> Logan, 3;<sup>51</sup> Marysvale, 2; Murray 1; Nephi, 1; Ogden, 8; Parowan, 1;<sup>52</sup> Provo, 5; Provo Canyon, 1;<sup>52</sup> Salt Lake City, 2.

<sup>40</sup> Mus. Vert. Zool.

<sup>50</sup> Carnegie Mus.

<sup>51</sup> Utah State Agr. College.

<sup>52</sup> Cleveland Mus. Nat. Hist.

## CITELLUS BEECHEYI (RICHARDSON)

[Synonymy under subspecies]

*Specific characters.*—Size small to medium; hind foot, 50–63.5 mm; tail, 137–198; skull length, 51.6–62.4. Skull essentially similar to that of *C. variegatus grammurus* except in size.

*Color.*—Head varying from avellaneous or pinkish cinnamon to wood brown or sayal brown; upper parts snuff brown, wood brown, or sayal brown, flecked with buffy white or cinnamon buff; sides of neck and shoulders white or whitish, this color extending backward as two divergent stripes to about the middle of the back, leaving a dark triangular area between; under parts buff, of varying intensity.

## CITELLUS BEECHEYI BEECHEYI (RICHARDSON)

CALIFORNIA GROUND SQUIRREL

(Pl. 8)

*Arctomys (Spermophilus) beecheyi* Richardson, Fauna Boreali-Americana 1: 170, 1829.

*Spermophilus beecheyi* F. Cuvier, Sup. a l'hist. natur. Buffon 1: 331, 1831.

[*Spermophilus grammurus*] var. *beecheyi* Allen, Boston Soc. Nat. Hist. Proc. 16: 293, 1874.

*Citellus variegatus beecheyi* Elliot, Field Columb. Mus. Pub., Zool. Ser. 6: 114, 1905.

*Otospermophilus beecheyi* Mearns, U. S. Natl. Mus. Bull. 56: 324, 1907.

*Citellus grammurus beecheyi* Miller, U. S. Natl. Mus. Bull. 79: 298, 1912.

*Citellus beecheyi beecheyi* Grinnell, Calif. Acad. Sci. Proc. (4) 3: 346, 1913.

*Otospermophilus grammurus beecheyi* Miller, U. S. Natl. Mus. Bull. 128: 180, 1924.

*Type.*—No. 222a, British Museum, skin with skull inside; locality not stated; habitat given as "neighborhood of San Francisco and Monterey, in California."

*Range.*—Western California, from San Francisco Bay south to northern San Diego County; eastward through the coast ranges and the San Gabriel Mountains (fig. 14). *Zonal range:* Upper Sonoran and Transition.

*External characters.*—Similar to *C. variegatus grammurus* but darker; white area of the shoulders divided by a dark triangular patch reaching to the crown; ears darker on outer surface. Similar to *C. b. douglasii*, but slightly darker; white shoulder patches less extensive, and foreback without a black patch between the white stripes. In comparison with the other races of *beecheyi*, this form is darker (more brownish) on the head and back, and more buffy on the under parts.

*Cranial characters.*—Skull similar to that of *C. v. grammurus* but smaller and relatively narrower in the postorbital region; nasals narrower posteriorly.

*Color.*—*Fresh fall pelage* (San Mateo County, Calif., December): Top of head pinkish cinnamon, shaded with fuscous; eye ring buffy white; ears fuscous black externally and on the upper margin, pale cinnamon buff on inner surface and posterior outer margin; hairs of upper parts fuscous black at base, tipped with pinkish cinnamon, the general tone near snuff brown; sides of neck and shoulders dull white, this color extending backward as two divergent stripes that fade out about the middle of the back; sides of body more or less

extensively flecked with dull white; feet pale pinkish buff; under parts pinkish buff; tail mixed black and pinkish buff.

*Variation.*—The pelage in summer is slightly paler, due to wear and fading.

*Molt.*—The annual molt occurs usually in July, but may be deferred until September. An adult male from Marysville Buttes, taken July 15, is in much worn pelage and shows new pelage starting in a small area on the fore back. An adult female taken on the same day at the same place is in old worn pelage and shows no indication of molting. A subadult male from Salinas, September 4, shows new pelage on the head and the posterior half of the body.

*Measurements.*—Average of 10 adult males from type region (Berkeley, Walnut Creek, Stanford University, Boulder Creek, Monterey, Mansfield): Total length, 434 (410–460); tail vertebrae, 177 (156–190); hind foot, 59 (57–61); ear from notch (dry), 19.9 (18–21). Average of 10 adult females from same section: Total length, 401 (370–442); tail vertebrae, 158 (137–180); hind foot, 56 (53–59); ear from notch (dry), 20.7 (19–22). *Skull:*

Average of 20 adult males from Contra Costa County: Greatest length, 59.4 (57–62.4); palatilar length, 28.8 (27–30.5); zygomatic breadth, 38.3 (36.3–40.5); cranial breadth, 24.5 (23.4–25.9); interorbital breadth, 14.7 (13.2–15.8); postorbital constriction, 15.7 (14.8–16.9); length of nasals, 22.1 (20–24); maxillary tooth row, 12 (11.2–12.9). Average of 20 adult females from same locality: Greatest

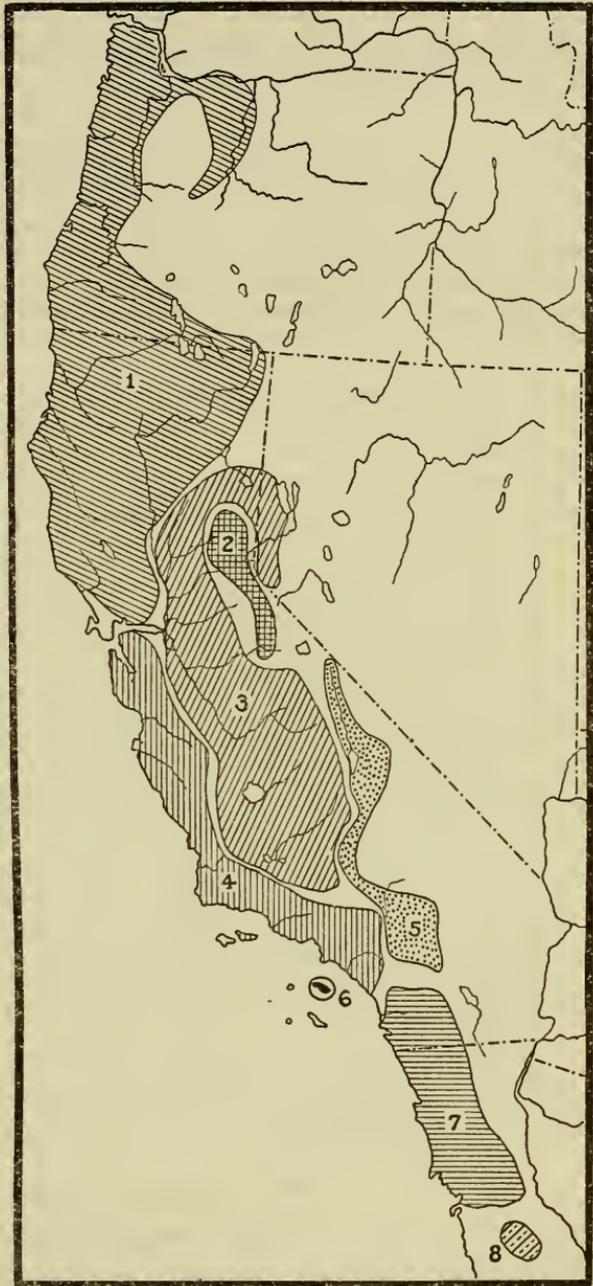


FIGURE 14.—Distribution of the subspecies of *Citellus beecheyi*: 1, *C. b. douglasii*; 2, *C. b. sierrae*; 3, *C. b. fisheri*; 4, *C. b. beecheyi*; 5, *C. b. parvulus*; 6, *C. b. nesioticus*; 7, *C. b. nudipes*; 8, *C. b. rupinarum*.

length, 57.1 (53.9–60.4); palatilar length, 27.5 (26–30); zygomatic breadth, 36 (33.6–38.6); cranial breadth, 23.6 (22.7–25.2); interorbital breadth, 13.8 (12.9–15.4); postorbital constriction, 15.6 (13.7–16.7); length of nasals, 21 (19.7–22.4); maxillary tooth row, 11.9 (10.6–12.7).

*Remarks.*—Any attempt to divide *C. beecheyi* into subspecies is certain to be unsatisfactory; this is because of the large amount of individual variation that is found in all races and also because of the diversified nature of the country in which the animals live. The present race is the darkest of all the forms and is typical only in the coastal region from San Francisco Bay southward to Ventura County; from there southward the animals become paler and smaller, grading into *C. b. fisheri* in the Tehachapi Mountains, into *C. b. parvulus* in the San Bernardino Mountains, and into *C. b. nudipes* in the coastal region of San Diego County. In many localities, the variation in the series is so great that while some of the specimens are typical of *beecheyi*, one or more may closely resemble one of the other subspecies.

*Specimens examined.*—Total number, 197, as follows:

**California:** Alhambra, 1; Aptos (5 miles south, Santa Cruz County), 2; Arroyo Seco (10 miles south of Paraiso Springs, Monterey County), 2; Arroyo Seco Canyon (near Pasadena, Los Angeles County), 3;<sup>63</sup> Bear Basin (head of Carmel River, Monterey County), 1; Berkeley, 2; Bitterwater (San Benito County), 3; Boulder Creek (Santa Cruz County), 3; Corral Hollow (8 miles southwest of Tracy), 1;<sup>63</sup> Contra Costa County, 50 (skulls);<sup>63</sup> Corralitos (Santa Cruz County), 11;<sup>64</sup> Del Norte (7 miles southeast, Monterey County), 6; Fremont Peak (Gabilan Range, Monterey County), 1; Gaviota Pass (Santa Barbara County), 2; Half Moon Bay, 1; Hayward, 1; Idria Mines (San Benito County), 4; Jamesburg (Monterey County), 1; Jolon (Monterey County), 1; Laguna Ranch (Gabilan Range, San Benito County), 1; Las Virgenes Creek (Los Angeles County), 1; Los Gatos, 1; Lytle Creek (San Bernardino County), 1; Mansfield (Monterey County), 4; Monterey, 6; Pacific Grove (Monterey County), 1; Paraiso Springs (Monterey County), 4; Paso Robles, 1; Pescadero, 1; Pine Valley (head of Carmel River, Monterey County), 2; Posts (Monterey County), 1; Pozo (San Luis Obispo County), 3; Priest Valley (Monterey County), 1; Redwood City, 1; Salinas, 1; San Francisco, 6; San Gabriel, 1; San Gabriel Mountains (Heninger Flats), 8; San Luis Obispo, 1; San Pedro (Point Firmin), 10; San Rafael Mountains (Santa Barbara County), 1; San Simeon (San Luis Obispo County), 2; Santa Barbara, 3; Santa Clara, 1; Santa Cruz, 2; San Mateo, 1; Santa Inez Mission (Santa Barbara County), 2; Santa Monica, 1; Seaside (Monterey County), 7; Sisquoc (Santa Barbara County), 3; Soledad, 1; Stanford University, 1; Strawberry Peak (San Gabriel Mountains), 1; Sur (Monterey County), 1; Tassajara (Contra Costa County), 1; Temescal (Riverside County), 2; Ventura River, 1; Walnut Creek (Contra Costa County), 5; Wilson Peak (Los Angeles County), 9.

#### CITELLUS BEECHEYI DOUGLASII RICHARDSON

##### DOUGLAS'S GROUND SQUIRREL

(Pls. 8; 26, B; 31, B)

*Arctomys?* (*Spermophilus?*) *douglasii* Richardson, Fauna Boreali-Americana, 1: 172, 1829.

*Spermophilus douglasii* F. Cuvier, Sup. a l'hist. natur. Buffon 1: 333, 1831.

[*Spermophilus grammurus*] var. *douglassi* Allen, Boston Soc. Nat. Hist. Proc. 16: 293, 1874.

*Citellus v. douglasi* Elliot, Field Columb. Mus. Pub., Zool. Ser. 3: 183, 1903.

*Citellus beecheyi douglasi* Grinnell, Calif. Acad. Sci. Proc. (4) 3: 345, 1913.

<sup>63</sup> Mus. Vert. Zool.

<sup>64</sup> Univ. Michigan Mus. Zool.

*Otospermophilus grammurus douglasii* Miller, U. S. Natl. Mus. Bull. 128: 180, 1924.

*Type*.—None designated; description based on a hunter's skin from the "banks of the Columbia" [River], sent to Richardson by David Douglas.

*Range*.—Western Oregon and northern California, from the Columbia River Valley south nearly to San Francisco Bay, Calif.; east to the Deschutes River Valley, Oreg.; Lake City, Calif., and a line reaching from the latter point to Eagle Lake, Lyonsville, Magalia, and Nelson; from there southward occurring only west of the Sacramento River (fig. 14). *Zonal range*: Mainly Upper Sonoran and Transition; into Lower Sonoran in the Sacramento Valley and into Canadian on the Siskiyou Mountains (6,000 feet) and the Scott Mountains (6,800 feet).

*External characters*.—Similar in general tone of upper parts to *C. b. beecheyi*, but averaging paler, especially on the head; a large triangular black patch on the foreback between the white shoulder patches; ears paler; under parts slightly paler; tail averaging longer, and paler underneath. Compared with *C. b. fisheri*: Back darker, with a black wedge between the shoulders; tail averaging longer, and deeper buff beneath.

*Cranial characters*.—Skulls of adult males average larger than those of *beecheyi* while skulls of females average smaller.

*Color*.—*Fresh pelage* (October): Nose and face smoke gray, washed with pinkish cinnamon; crown mikado brown or cinnamon; ears fuscous on outer surface, pale cinnamon buff on inner surface; eye ring creamy white; shoulder patches pale smoke gray, enclosing a wedge-shaped patch of fuscous black; general tone of hinder back near sayal brown, mottled with pale smoke gray or pale pinkish buff; front feet pinkish buff; hind feet varying from cartridge buff to cinnamon buff; tail above, mixed black and pale pinkish buff, the hairs edged with grayish white; tail beneath, cinnamon buff or light ochraceous buff, more or less obscured with grayish white; under parts cartridge buff, pinkish buff, or grayish white.

*Variation*.—Occasional specimens lack the black patch on the back; in a series of 20 specimens from The Dalles, Oreg., one in fresh pelage lacks the black patch entirely and four in worn pelage have the black nearly obliterated.

*Molt*.—The annual molt takes place usually in June or July, but may sometimes be delayed till August or early September. Certain individuals in spring and early summer become greatly worn before molting, so that the blackish patch on the fore back becomes faded or nearly obliterated.

Specimens taken at The Dalles, Oreg., June 10, show new pelage coming in on the head and fore back; female specimens from Stillwater, Calif., July 1, and Drew, Oreg. July 28, are in similar condition of pelage; nursing females from Forest Grove, Oreg., July 16, and Tower House, Calif., August 4, are in badly worn pelage and had not started to molt; another nursing female, from Chico, Calif., September 19, had just acquired a fresh pelage over the anterior half of the back, the hinder back being in worn and faded pelage.

*Measurements*.—Average of 10 adult males from Oregon: Total length, 476 (450–500); tail vertebrae, 207 (190–223); hind foot, 61 (56–63); ear from notch

(dry), 19.5 (17.5-22). Average of 10 adult females from Oregon: Total length, 450 (440-460); tail vertebrae, 193 (182-200); hind foot, 58.6 (57-60); ear from notch (dry), 18.4 (17-20). *Skull*: Average of 8 adult males from Oregon: Greatest length, 61.5 (59.2-63.2); palatilar length, 30.1 (29.2-31); zygomatic breadth, 38.1 (36.3-39.9); cranial breadth, 24.5 (24-25); interorbital breadth, 14.2 (13.3-15.7); postorbital constriction, 15.1 (14.5-15.8); length of nasals, 22 (20.5-23.5); maxillary tooth row, 11.5 (11.1-12). Average of 10 adult females from The Dalles, Oreg.: Greatest length, 56.1 (54.6-57.8); palatilar length, 26.9 (26-27.8); zygomatic breadth, 34.1 (33.2-35.3); cranial breadth, 23.1 (22-24); interorbital breadth, 12.8 (11.5-13.4); postorbital constriction, 15.8 (14.9-16.9); length of nasals, 19.3 (18.5-20.6); maxillary tooth row, 10.8 (10.1-11.2).

*Remarks*.—Douglas's ground squirrel is closely related to *beecheyi*, differing chiefly in having a large black patch on the fore-back between the whitish side stripes; the range of *douglasii* is separated from that of *fisheri* by the Sacramento River for a considerable distance in central California, but in the vicinity of Chico, *douglasii* crosses to the east side of the river and meets the range of *fisheri* in Butte County. Typical specimens of *douglasii* have been collected at points nine miles east of Chico and eight miles east of Nelson. At Oroville and Yankee Hill typical *fisheri* occurs, while at Cherokee and Pentz typical specimens of each and some with intermediate characters have been taken. This condition suggests hybridization rather than the usual type of intergradation, but in consideration of the close resemblance between the two forms in color and with no important difference between them in skull characters, it seems best to treat them as subspecies.

The present species is reported to have crossed the Columbia River and established itself near White Salmon, Wash., within very recent times. In July 1917, W. N. Suksdorft stated that it had come in within the past 2 or 3 years and had already spread for 2 or 3 miles up the river valley.

*Specimens examined*.—Total number, 338, as follows:

California: Adin (Modoc County), 7; Bald Mountain (8 miles south, Shasta County), 2; Balls Ferry (Shasta County), 1;<sup>55</sup> Bartlett Mountain (Lake County), 2; Bear Creek Valley (Shasta County), 1; Beswick (Siskiyou County), 6; Bieber (Lassen County), 1; Branscomb (Mendocino County), 1;<sup>56</sup> Burney (Shasta County), 4; Cahto (Mendocino County), 1; Calpella (Mendocino County), 1; Cassell (Shasta County), 5; Cherokee (Butte County), 2;<sup>56</sup> Chico, 17; Cloverdale, 3; Dana (Shasta County), 3; Davis, 1; Dry Creek (Butte County), 4;<sup>56</sup> Eagle Lake (Lassen County), 2; Eel River (Humboldt County), 6; Elmira (Solano County), 1; Eureka, 3;<sup>57</sup> Fairfield, 6; Fall River Mills, 1; Fort Crook (Shasta County), 6; Glen Ellen (Sonoma County), 13; Goose Lake, 3; Guenoc (Lake County), 1; Hayden Hill (Lassen County), 4; Healdsburg, 1; Hoopa Valley (Humboldt County), 7; Hornbrook, 3; Mad River (Carson's Camp, Humboldt Bay), 2; Lake City (Modoc County), 1; Lakeport, 1; Lower Lake (Lake County), 3; Lyonsville (Tehama County), 2; Magalia (Butte County), 1; Merrillville (Lassen County), 1; Middletown (Lake County), 1; Mill Creek (east of Lyonsville, Tehama County), 1; Montague, 1; Mount George (Napa County), 1; Mount St. Helena (Sonoma County), 2; Mount Veeder (10 miles N. W. of Napa), 2; Nelson (Butte County), 2; North Yolla Bolly Mountain (12 miles north, Trinity County), 1;<sup>58</sup> Paynes Creek (Tehama County), 1; Pentz (Butte County), 4;<sup>56</sup> Petaluma, 3; Pittville (Shasta County), 1; Red Bluff, 11; Redding, 5; Redding-Bieber road (12 miles west of Burney), 3; Round Mountain (Shasta County), 1; Saint John (Glenn County), 3; Salt Creek (6 miles northwest of Baird, Shasta County), 1; Salmon Mountains (near Etna Mills, Siskiyou County), 5; Shasta Valley

<sup>55</sup> Univ. Michigan Mus. Zool.

<sup>56</sup> Mus. Vert. Zool.

<sup>57</sup> Field Mus. Nat. Hist.

(Siskiyou County), 1; Sherwood (Mendocino County), 3; Siskiyou Mountains (White Mountain), 7; Sisson (Siskiyou County), 8; Sites (Colusa County), 1; Smith River (Del Norte County), 2; South Yolla Bolly Mountain (Trinity County), 1; Stillwater (Shasta County), 2; Tehama, 1; Tower House (near Bally Mountain, Shasta County), 1; Tule Lake (east side), 1; Ukiah, 5.

Oregon: Ashland, 3; Beaverton (Washington County), 1; Blaine (Tillamook County), 3;<sup>55</sup> Dog Lake Ranger Station (30 miles southwest of Lakeview), 1; Douglas County (22 miles east of Drew), 1; Elk Head (Douglas County), 1; Eugene, 3; Farrea Ranger Station (13 miles southwest of Galice), 1; Forest Grove, 11; Fort Klamath, 1;<sup>55</sup> Gold Beach, 4;<sup>57</sup> Grants Pass, 10; Hood River, 4; Klamath Lake, 2; Mapleton (Lane County), 1; Maupin (Wasco County), 8; McCoy (Polk County), 4; McKenzie Bridge (10 miles east, Lane County), 5; Miller (Sherman County), 3; Mount Hood (north slope, 2,800 feet altitude), 1; Naylox (=Algoma, Klamath Lake), 2; Oregon City, 1; Philomath, 3; Portland, 2; Prospect (Jackson County), 6; Reston (Douglas County), 1; Rogue River Valley (near Grants Pass), 4; Roseburg, 5; Salem, 3;<sup>55</sup> Scottsburg (Douglas County), 1; Siskiyou (Jackson County), 1; The Dalles, 20; Tillamook, 1;<sup>55</sup> Wapinitia (Wasco County), 1; Warm Springs (Jefferson County), 2; Warm Springs River (Wasco County), 2.

Washington: White Salmon, 3.

CITELLUS BEECHEYI SIERRAE, SUBSP. NOV.

SIERRA GROUND SQUIRREL

*Type*.—Collected at Emerald Bay, Lake Tahoe, Calif., May 23, 1897, by J. Alden Loring; female adult, skin and skull, no. 88421, U. S. Natl. Mus. (Biological Survey collection) (orig. no. 4166.)

*Range*.—Higher parts of the northern Sierra Nevada, from Plumas County south to Mariposa County (upper Merced River) (fig. 14).  
*Zonal range*: Transition and Canadian.

*External characters*.—Similar in size and color of upper parts to *C. b. beecheyi*; sides of head more grayish (less buffy); feet more whitish (less buffy); under parts averaging paler (more whitish); under side of tail more grayish (less buffy). Compared with *C. b. fisheri*: Head and upper parts distinctly darker; feet more whitish (less buffy); tail darker and less buffy beneath.

*Cranial characters*.—Skull similar to that of *beecheyi*, but averaging slightly smaller, except in the postorbital breadth, which is greater.

*Color*.—*Winter pelage* (type, May 23): Head sayal brown, washed with grayish white; sides of face fuscous, the hairs tipped with grayish white; ears fuscous black, shaded on posterior margin with grayish buff; general tone of upper parts pale sayal brown, flecked with buffy white; sides of neck and shoulders with a heavy wash of grayish white, and sides of body less heavily washed with the same; hind feet grayish white, front feet pale buffy white; tail above, fuscous black, mixed with grayish white; tail beneath, mixed buffy white and fuscous black; under parts pinkish buff.

*Variation*.—In some specimens, the upper parts are snuff brown, flecked with cinnamon buff and buffy white; the head is sometimes pure sayal brown, without grayish wash.

*Measurements*.—Average of 3 adult males from vicinity of Lake Tahoe (Emerald Bay, Tallac, and Emigrant Gap): Total length, 452 (440–470); tail vertebrae, 178 (170–190); hind foot, 57.7 (54–63); ear from notch (dry), 20

<sup>55</sup> Univ. Michigan Mus. Zool.

<sup>57</sup> Field Mus. Nat. Hist.

(19-21.5). Average of 10 adult females from Emerald Bay, Donner, and Little Yosemite: Total length, 422 (400-455); tail vertebrae, 172 (159-184); hind foot, 56.2 (54-60); ear from notch (dry), 20.3 (18.5-23). *Skull*: Average of 5 adult males from Emerald Bay, Blue Canyon, and Emigrant Gap: Greatest length, 58 (56.5-59.5); palatilar length, 27.7 (26.5-29); zygomatic breadth, 36.7 (34.9-37.8); cranial breadth, 23.5 (22.4-24.6); interorbital breadth, 14.1 (12.9-15.5); postorbital constriction, 16.1 (15.7-17.1); length of nasals, 20.9 (20.5-21.9); maxillary tooth row, 11.4 (11-11.8). Average of 11 adult females from Emerald Bay, Blue Canyon, and Donner: Greatest length, 56.6 (53.1-59.9); palatilar length, 27 (25-28); zygomatic breadth, 34.4 (33.1-36.9); cranial breadth, 23.4 (22.7-24.9); interorbital breadth, 14 (13.5-15); postorbital constriction, 16.2 (15.2-17); length of nasals, 20.8 (19.5-21.8); maxillary tooth row, 11.1 (10.5-11.7).

*Remarks*.—The Sierra ground squirrel bears a close resemblance to typical *beecheyi*, but differs in certain minor characters as pointed out above; it might be included with *beecheyi* except for the fact that their ranges are not contiguous, being separated by the range of *fisheri*, the pale form occupying the San Joaquin and Sacramento Valleys. Intergradation with *fisheri* occurs in the southern Sierra Nevada and along the lower slopes on the western side of the range.

*Specimens examined*.—Total number 39, as follows:

**California**: Big Trees (Calaveras County), 1; Blue Canyon (Placer County), 14; Downieville, 1; Emerald Bay (Lake Tahoe), 5; Emigrant Gap (Placer County), 1; Little Yosemite (Mariposa County), 1; Markleeville (Alpine County), 4; Merced River (near head), 3; Quincy, 1; Summit (=Donner, Placer County), 5; Tallac (Eldorado County), 2; Wawona (south fork Merced River, Mariposa County), 1.

#### CITELLUS BEECHEYI FISHERI MERRIAM

##### FISHER'S GROUND SQUIRREL

*Spermophilus beecheyi fisheri* Merriam, Biol. Soc. Wash. Proc. 8: 133, Dec. 28, 1893.

[*Spermophilus grammurus*] *fisheri* Elliot, Field Columb. Mus. Pub., Zool. Ser. 2: 88, 1901.

*Citellus variegatus fisheri* Elliot, Field Columb. Mus. Pub., Zool. Ser. 3: 211, 1903.

*Citellus beecheyi fisheri* Grinnell, Calif. Acad. Sci. Proc. (4) 3: 346, 1913.

*Otospermophilus grammurus fisheri* Miller, U. S. Natl. Mus. Bull. 128: 181, 1924.

*Type*.—Collected on South Fork of Kern River, 3 miles above Onyx, Kern County, Calif., July 6, 1891, by A. K. Fisher; male sub-adult; skin and skull, no.  $\frac{29318}{41335}$ , U. S. Natl. Mus. (Biological Survey collection) (orig. no. 741).

*Range*.—Greater part of central California, including the San Joaquin and Sacramento Valleys and the southern Sierra Nevada; north on the eastern side of the Sacramento River to southern Butte County, then northeastward to Susanville; east to the western side of Pyramid Lake, Nev., and to Walker Pass, in the southern Sierra Nevada, Calif.; south to the Tehachapi Mountains; west to Cuyama Valley, the Carriso Plain, and the western border of the San Joaquin Valley (fig. 14). *Zonal range*: Upper Sonoran and Transition.

*External characters*.—Similar in size to *C. b. beecheyi*, but hind feet shorter; coloration paler, both above and below; light markings on shoulders more prominent and clearer white.

*Cranial characters*.—Skull similar to that of *beecheyi* but averaging smaller, especially in the females; zygomata less widely expanded.

*Color.*—*Summer pelage* (Kern Valley): Top of head and face light pinkish cinnamon; sides of face pale smoke gray; a large patch of clear creamy white on each shoulder, this color extending to the middle of the back in two narrow stripes separated by a dark area more or less triangular in shape; rest of upper parts about wood brown in general tone, flecked with patches of creamy white; feet pale buff or buffy white; tail mixed fuscous black and pinkish buff; under parts creamy white to pinkish buff. *Winter pelage* (Modesto, February): General tone of upper parts (excepting head) pale smoke gray, faintly washed with pale pinkish buff; under parts pale pinkish buff; tail mixed fuscous black and pale pinkish buff.

*Molt.*—The annual molt may occur at any time between May and August; an adult male from Modesto, taken May 8, shows new pelage coming in on the head, nape, and fore back; a male taken at Milford (Honey Lake), June 20, shows new pelage covering the posterior half of the body, and small areas on the head, shoulders, and fore back; a male from Biggs, Butte County, shows small areas of new pelage on the crown and in the middle of the back, behind the shoulders; a male from Carriso Plain, taken August 1, shows new pelage on the head and a large patch on the hinder back.

*Measurements.*—Average of 7 males (adult and subadult) from Kern River Valley and Walker Basin: Total length, 442 (415–475); tail vertebrae, 183 (175–198); hind foot, 57.6 (54–62); ear from notch (dry), 18.4 (17–20). Average of 4 adult females from Kern River Valley: Total length, 407 (390–427); tail vertebrae, 162 (155–170); hind foot, 52.7 (50–56); ear from notch (dry), 18.3 (17–20). Average of 11 adult males from Modesto: Total length, 457 (433–500); tail vertebrae, 167 (149–190); hind foot, 60.1 (55–63); ear from notch (dry), 19.3 (17.5–21); average of 4 adult females from Modesto: 423; 168; 55.4; 17.7. *Skull:* Average of 4 adult males from Kern River Valley and Walker Basin: Greatest length, 59.3 (57–60.9); palatilar length, 28.7 (27.5–30); zygomatic breadth, 36.9 (36.6–37.4); cranial breadth, 24.2 (23.8–24.7); interorbital breadth, 13.5 (11.5–14.3); postorbital constriction, 16 (15.2–17); length of nasals, 22.2 (21.5–22.8); maxillary tooth row, 11.8 (11.7–12). Average of 3 adult females from Kern River Valley: Greatest length, 55.8 (55.6–56); palatilar length, 26.5 (26–27); zygomatic breadth, 34.2 (33.9–34.6); cranial breadth, 23.1 (22.4–23.5); interorbital breadth, 13.7 (13.4–14); postorbital constriction, 15.3 (14.6–16); length of nasals, 20.1 (19.6–20.8); maxillary tooth row, 11.4 (11.1–11.7). Average of 15 adult males from Modesto: Greatest length, 59.5 (55.5–62); palatilar length, 29.9 (27.5–31); zygomatic breadth, 37.5 (34.2–38.9); cranial breadth, 23.8 (22.2–24.9); interorbital breadth, 14.5 (13.3–16.5); postorbital constriction, 16 (15–16.9); length of nasals, 21.8 (20.2–22.8); maxillary tooth row, 11.7 (11.1–12.3). Average of 6 adult females from Modesto: Greatest length, 56.3 (55.3–57.5); palatilar length, 27.1 (26–28); zygomatic breadth, 35 (33.8–35.8); cranial breadth, 23.4 (22.7–24.8); interorbital breadth, 13.7 (12.6–14.7); postorbital constriction, 15.5 (14.6–15.9); length of nasals, 20 (19.2–20.7); maxillary tooth row, 11.6 (10.9–12.)

*Remarks.*—Fisher's ground squirrel is about the size of *beecheyi*, but averages decidedly paler in color; it is similar to *C. b. parvulus* in color, but is distinctly larger. Over its extensive range in both valley and mountain country it is subject to considerable variation in color, and many individual specimens are scarcely different from some individuals of *beecheyi*.

Intergradation with *beecheyi* occurs along the western side of the San Joaquin Valley and in the Tehachapi Mountains, with *sierrae* in the foothills of the Sierra Nevada and with *douglasii* in Butte County.

*Specimens examined.*—Total number, 279, as follows:

California: Alcalde (Fresno County), 3; Allia (=Earlimart, Tulare County), 8; Alta Peak (Kaweah River, Tulare County), 1; Aspen Meadow (Yosemite National Park), 4; Auburn (Placer County), 2; Bakersfield (8 miles northeast), 1,<sup>58</sup> Biggs, 3; Bodfish (Kern County), 1;<sup>58</sup> Camp Badger (Tulare County), 1; Cannell Meadow (Tulare County), 1;<sup>58</sup> Carbondale (Amador County), 2; Carriso Plain, 5; Claribel (Stanislaus County), 1;<sup>58</sup> Colusa (6 miles east), 1; Coulterville, 1; Cuyama Valley (San Luis Obispo County), 2; Dos Palos, 1; Dry Creek (Butte County), 1;<sup>58</sup> Earlimart, 2;<sup>58</sup> Eshom Valley (Tulare County), 1; Feather River Station (Butte County), 2;<sup>58</sup> Fort Tejon (Kern County), 13; Fresno 4; Fresno Flat (Madera County), 4; Grabner (Fresno County), 6;<sup>58</sup> Greenvale (Plumas County), 1; Horse Corral Meadows (Fresno County), 1; Jackass Meadow (Tulare County), 1;<sup>58</sup> Jordan Hot Springs (Tulare County), 1;<sup>58</sup> Kern Lake (Tulare County), 1; Kern River (15 miles northeast of Bakersfield), 1; Kern River (Isabella and 12 miles below Bodfish), 4;<sup>58</sup> Kern River (South Fork, near Onyx), 12; Kernville, 2; La Grange (Stanislaus County), 1; Lemoore, 3; Long Valley (Lassen County), 1; Los Banos (Merced County), 9; Maricopa, 4;<sup>58</sup> Marysville, 1; Marysville Buttes, 7; Milford (Lassen County), 2; Milo (Tulare County), 2; Mineral King (East Fork Kaweah River, Tulare County), 1; Modesto, 31; Mono Flats (Santa Barbara County), 2; Mountain House (6 miles southwest of Downieville), 2; Mount Pinos, 7; Mount Whitney, 1; Nevada City, 2; Orosi (Tulare County), 7; Oroville (Butte County), 1;<sup>58</sup> Pacheco Pass (Santa Clara County), 2; Placerville (Eldorado County), 3; Plumas County, 1; Porterville, 1; Prattville (Plumas County), 2; Raymond (Madera County), 2; Redwood Mountain (General Grant National Park), 1; Ripon, 2; Rose Station (6 miles north of Old Fort Tejon), 2; Sacramento, 3; Salt Springs (Fresno River, 30 miles east of Raymond), 1; San Emigdio (Kern County), 1; San Emigdio Canyon, 2; San Emigdio Creek, 2;<sup>58</sup> Sierra Valley (Plumas County), 2; Sequoia National Park, 2; Sequel Mill (head of North Fork of San Joaquin River), 2; Sunset Station (near Maricopa, Kern County), 1; Susanville, 1; Taylor Meadow (Tulare County), 5;<sup>58</sup> Tehachapi, 2; Tehachapi Peak, 3; Tejon Canyon, 3; Tejon Pass, 4; Three Rivers (Tulare County), 2; Tipton (Tulare County), 5;<sup>58</sup> Tracy, 1; Trout Creek (Tulare County, altitude 6,000 feet), 3;<sup>58</sup> Trout Meadows (Tulare County), 1; Volta (Merced County), 2; Walker Basin (Kern County), 1; Walker Pass (Kern County), 4; Weldon (Kern County), 3; Yankee Hill (Butte County), 1; Yosemite Valley, 3; Zaca Lake (Santa Barbara County), 1.

Nevada: Carson City, 1; Genoa, 1; Glenbrook (Douglas County), 3; Pyramid Lake (west side), 4; Reno, 3; Verdi, 6; Virginia Mountains (Washoe County), 1.

CITELLUS BEECHEYI PARVULUS HOWELL

LESSER CALIFORNIA GROUND SQUIRREL

(Pls. 26, A; 31, A)

*Citellus beecheyi parvulus* Howell, Jour. Mammal. 12: 160, May 14, 1931.

*Type.*—Collected in Shepherd Canyon, Argus Mountains, Calif., April 30, 1891, by A. K. Fisher; female subadult, skin and skull, no.  $\frac{28068}{40187}$ , U. S. Natl. Mus. (Biological Survey collection) (orig. no. 569).

*Range.*—Desert ranges of southern California (except the Providence Mountains); north to Owens Valley; south to the San Jacinto Mountains (fig. 14). *Zonal range:* Mainly Upper Sonoran and Transition, but extending into Lower Sonoran.

*Cranial characters.*—Similar to *C. b. fisheri*, but smaller.

*Color.*—Not appreciably different from that of *fisheri*.

<sup>58</sup> Mus. Vert. Zool.

<sup>59</sup> Cleveland Mus. Nat. Hist.

*Measurements.*—Average of 10 adult males from Panamint Mountains, Argus Mountains, and Owens Valley: Total length, 411.8 (383-435); tail vertebrae, 162.8 (155-179); hind foot, 54.8 (50-58); ear from notch (dry), 19.8 (18-21). Average of 12 adult females from same section: Total length, 410 (385-455); tail vertebrae, 163 (145-180); hind foot, 52.9 (50-56); ear from notch (dry), 19 (17-22). *Skull:* Average of 7 adult males from Panamint Mountains, Argus Mountains, Lone Pine, and Owens Lake: Greatest length, 56.3 (53.9-60.5); palatilar length, 26.8 (25-28); zygomatic breadth, 35.3 (34-36.4); cranial breadth, 23.3 (22.7-24.4); interorbital breadth, 12.8 (11.8-13.3); postorbital constriction, 14.9 (13.6-16.1); length of nasals, 20.9 (19.4-22.2); maxillary tooth row, 11.1 (10.9-11.8). Average of 9 adult females from same region: Greatest length, 53.9 (52.2-54.8); palatilar length, 25.4 (25-26); zygomatic breadth, 33.6 (32.6-34.7); cranial breadth, 23.2 (22.8-24.1); interorbital breadth, 13.3 (12.4-14.1); postorbital constriction, 15.8 (14.8-16.4); length of nasals, 19.4 (18.6-20.8); maxillary tooth row, 11.3 (10.8-11.7).

*Weight.*—One old female from Olancha weighed 655 g.

*Remarks.*—In the original description of this race, the present writer defined its range as extending southward to the San Pedro Martir Mountains, Baja California; since then, Huey (1931, p. 18) has described the form from northern Baja California as *C. b. nudipes*, and as a result of further intensive study of a large series of specimens from the type region of *nudipes* and from extreme southern California, it seems proper to restrict the name *parvulus* to the small California race as far south as the San Jacinto Mountains, and to refer the series from San Diego County southward to *nudipes*.

Huey objects to the recognition of *parvulus* on the ground that there is no appreciable difference between specimens from the type locality of *fisheri* (South Fork of Kern River) and those from the type locality of *parvulus* (Argus Mountains); comparison of the cranial measurements of seven specimens (four males, three females) of *fisheri* from the type region given on page 155 with the measurements of *parvulus* (above) shows, however, a decided difference in size of the skulls. It is true that the topotype series of *fisheri* is slightly smaller in average cranial measurements than the series from the San Joaquin Valley, but the difference in size is much less than between topotypes of *fisheri* and of *parvulus*.

The present race intergrades with *fisheri* in the Piute Mountains, with *C. b. beecheyi* in the San Bernardino Mountains, and with *nudipes* in the San Jacinto Mountains. The series from the San Bernardino Mountains is so nearly intermediate between *beecheyi* and *parvulus* that it makes little difference which name is applied to it; in fact, some specimens are practically typical of one race, some of the other. The skulls average smaller than those of *beecheyi*. The series from the San Jacinto Mountains is likewise intermediate between *parvulus* and *nudipes*, but a little nearer *parvulus*. The skulls average a little smaller than the San Bernardino series.

*Specimens examined.*—Total number, 160, as follows:

California: Argus Range (Inyo County), 3; Andreas Canyon (Riverside County), 1;<sup>60</sup> Banning, 13; Cabazon (Riverside County), 11;<sup>60</sup> Cameron (Kern County), 2; Coso (Inyo County), 6; El Casco (Riverside County), 1; Hesperia (San Bernardino County), 2; Independence, 4;<sup>60</sup> Independence Creek (6,500 feet altitude), 1; Jackass Spring, Panamint Mountains, 11;<sup>60</sup> <sup>62</sup> Little Lake (Inyo County), 2; Little Onion Valley (Inyo County), 1;<sup>60</sup> Little Cottonwood Creek (Inyo County), 1;<sup>60</sup> Lone Pine, 5; Mount Williamson (N. E. base), Owens Valley, 3;<sup>61</sup> Old Camp Independence,

<sup>60</sup> Mus. Vert. Zool.

<sup>61</sup> Cleveland Mus. Nat. Hlst.

<sup>62</sup> Two in Cleveland Mus. Nat. Hlst.

Owens Valley, 1;<sup>61</sup> Olancha (Inyo County), 1;<sup>60</sup> Oro Grande, 8; Owens Lake, 6; Owens Valley, 2; Panamint Mountains, 5; Piute Mountains, 1; Palm Springs, 8; Reche Canyon (San Bernardino County), 4; Riverside, 1; San Bernardino, 7; San Bernardino Mountains, 15; San Jacinto Mountains, 32;<sup>62</sup> Snow Creek (near Whitewater, Riverside County), 1;<sup>60</sup> Victorville, 1.<sup>60</sup>

### CITELLUS BEECHEYI NUDIPES HUEY

#### JUAREZ GROUND SQUIRREL

*Citellus beecheyi nudipes* Huey, San Diego Soc. Nat. Hist. Trans. 7: 18, Oct. 6, 1931.

*Type*.—Collected at Hanson Laguna, Sierra Juarez, Baja California, Mexico (latitude 31° 58' north, longitude 115° 53' west; altitude 5,200 feet), October 13, 1926, by Frank Stephens; female adult, skin and skull, no. 2015, San Diego Soc. Nat. Hist.

*Range*.—Northern Baja California and extreme southwestern California, including most of the western half of San Diego County (fig. 14). *Zonal range*: Upper and Lower Sonoran and Transition.

*External characters*.—Similar to *C. b. beecheyi* but smaller and with paler feet and under parts and more conspicuous shoulder patches; similar in size to *C. b. parvulus* but darker.

*Cranial characters*.—Skull closely similar to that of *parvulus*; smaller than those of *beecheyi* and *C. b. fisheri*.

*Color*.—*Fresh winter pelage* (topotypes, October): Head wood brown; shoulder patches grayish white, strongly contrasted with the color of the back; dorsal area snuff brown, flecked with light pinkish cinnamon; sides more heavily flecked with grayish white; feet cartridge buff; under parts grayish white, faintly washed with pale pinkish buff; tail black, mixed with white or buffy white. *Summer pelage* (San Pedro Martir Mountains, July): Dorsal area paler (less brownish) than in winter, the general tone on the back near wood brown, with a pinkish tinge, the sides more grayish. In certain summer specimens in worn pelage—notably one from San Telmo, August 22—the general tone of the dorsal area is near cinnamon. In some also, the anterior back, between the white shoulder patches, is blackish brown, due in large part to the wearing away of the tips of the hairs and exposure of the dark basal portion.

*Molt*.—A specimen from the San Pedro Martir Mountains, taken June 29, is in badly worn pelage and shows a fresh pelage coming in over the anterior half of the back; several from Trinidad Valley, taken July 10 to 16, show a fresh pelage on the rump, the rest of the back being much worn.

*Measurements*.—Average of 8 adult males from San Pedro Martir Mountains: Total length, 411.6 (386–442); tail vertebrae, 177 (162–196); hind foot, 56.1 (52–62); ear from notch (dry), 18.5 (17–20). Average of 11 adult females from Hanson Laguna, Trinidad Valley, and San Pedro Martir Mountains: Total length, 397 (357–435); tail vertebrae, 156.5 (146–186); hind foot, 53.7 (50–57); ear from notch (dry), 19 (17–20). *Skull*: Average of 6 adult males from Hanson Laguna, Trinidad Valley, San Pedro Martir Mountains, and San Telmo: Greatest length, 56.8 (54.859.5); palatilar length, 27 (26–28); zygomatic breadth, 35.2 (32.8–35.9); cranial breadth, 23.5 (22.8–24.4); interorbital breadth, 13.7 (11.4–14.8); postorbital constriction, 16 (15.2–18.1); length

<sup>60</sup> Mus. Vert. Zool.

<sup>61</sup> Cleveland Mus. Nat. Hist.

<sup>62</sup> Eighteen in Mus. Vert. Zool.

of nasals, 20.4 (19-21.7); maxillary tooth row, 11.2 (10.6-12). Average of 10 adult females from San Pedro Martir Mountains and Hanson Laguna: Greatest length, 54.6 (51.6-56.1); palatilar length, 25.8 (23.5-27); zygomatic breadth, 34.2 (32.3-35.2); cranial breadth, 23 (22.2-24.7); interorbital breadth, 13.3 (12.2-14.6); postorbital constriction, 16.1 (15.6-17.3); length of nasals, 19.5 (17.5-20.6); maxillary tooth row, 11.1 (10.4-11.7).

*Remarks.*—This is a small, dark race, nearest in general coloration to *beecheyi*, but with more conspicuous white shoulder patches and paler under parts. It averages slightly larger in external measurements than *parvulus*, though the skulls of these two races are closely similar. Where their ranges meet in the mountains of San Diego County, Calif., many intermediate specimens are found. In the series examined from Santa Ysabel, Witch Creek, Twin Oaks, Jacumba, Nachoguero Valley, and Dulzura, some of the specimens are fairly typical of *nudipes*, while others are much paler and might almost as well be referred to *parvulus*. A large series from San Ysidro Ranch, on the Mexican boundary line, 19 miles east of the Pacific Ocean, are very similar in size and general coloration to *nudipes*, but have somewhat more buffy under parts, thus showing approach to *beecheyi*. The series from around San Diego Bay is still more like *beecheyi* in color, though agreeing with *nudipes* in smaller size of skull and hind feet. A series of 10 specimens from Point Loma is about as dark on the upper parts as *beecheyi* but the under parts are decidedly paler. Four specimens from San Diego and one from mouth of Tia Juana River agree both in color and size with typical *nudipes* except for somewhat more buffy under parts. Another individual from Tia Juana River is about as dark as *beecheyi*, both above and below.

*Specimens examined.*—Total number, 163, as follows:

**Baja California:** Descanso Bay (north side), 1; <sup>65</sup> El Rayo, Hanson Laguna Mountains, 2; Ensenada, 1; Hanson Laguna, 1; Las Encinos, 1; <sup>66</sup> Nachoguero Valley (near Monument 237, Mexican boundary line), 5; San Pedro Martir Mountains, 22 (including La Grulla, 2; Pihyon, 2; Rancho San Antonio, 9; Rancho Santo Tomas, 1; Vallecitas, 5); San Telmo, 1; San Quentin, 3; <sup>66</sup> San Matias Pass, 1; San Ysidro Ranch (near Monument 250, Mexican boundary line), 15; Tecarte Valley, 1; Trinidad Valley, 6.<sup>65</sup>

**California:** Campo (San Diego County), 1; <sup>64</sup> Chula Vista, 3; <sup>61</sup> Cuyamaca Mountains (San Diego County), 4; <sup>64</sup> Dulzura (San Diego County), 16; Grapevine Spring (San Diego County), 1; <sup>61</sup> Jacumba Springs, 5; Jamul Creek (San Diego County), 1; Julian (San Diego County), 8; <sup>64</sup> Laguna Mountains (San Diego County), 16; Lakeside (San Diego County), 2; <sup>64</sup> Mountain Spring (4 miles north of Monument 231, Mexican boundary line), 8; Oceanside (San Diego County), 2; Pacific Ocean, at Mexican boundary line, 1; Point Loma (San Diego County), 10; <sup>64</sup> San Diego, 6; Santa Ysabel (San Diego County), 4; Tia Juana River (mouth), 2; Twin Oaks (San Diego County), 2; Warner Pass (San Diego County), 3; <sup>64</sup> Witch Creek (San Diego County), 8.<sup>64</sup>

#### CITELLUS BEECHEYI RUPINARUM HUEY

##### CATAVINA GROUND SQUIRREL

*Citellus beecheyi rupinarum* Huey, San Diego Soc. Nat. Hist. Trans. 7: 17, Oct. 6, 1931.

*Type.*—Collected at Catavina, Baja California, Mexico (latitude 29°54' north, longitude 114°57' west), October 9, 1930, by Laurence

<sup>61</sup> Mus. Vert. Zool.

<sup>65</sup> San Diego Soc. Nat. Hist.

<sup>66</sup> Field Mus. Nat. Hist.

M. Huey; female subadult, skin and skull, no. 8251, San Diego Soc. Nat. Hist.

*Range*.—Deserts of central Baja California, south of the San Pedro Martir Mountains; southern limits unknown (fig. 14). *Zonal range*: Lower Sonoran.

*External characters*.—Similar to *C. b. nudipes*, but paler (less brownish) dorsally and without darker area on anterior back; shoulder patches less prominent; head slightly paler (less reddish). Closely similar to *C. b. parvulus*, but shoulder patches less distinct and front feet apparently darker buff.

*Cranial characters*.—Skull very similar to that of *nudipes*, averaging slightly smaller and relatively narrower across zygomata.

*Color*.—*Winter pelage* (Oct. 9): Head pale wood brown or avel-laneous; shoulder patches grayish white or creamy white; dorsal area sayal brown, flecked with pinkish buff; feet cartridge buff; under parts creamy white, washed with pinkish buff on lower abdomen; tail mixed black and pale pinkish buff.

*Molt*.—A specimen from San Fernando, taken September 5, shows patches of new pelage on the top of the head and between the shoulders, the remainder of the pelage being moderately worn. A specimen from Catavina, taken on October 9, has acquired a nearly complete new pelage except on the nape and shoulders.

*Measurements*.—Average of 4 adult females: Total length, 421 (415-425); tail vertebrae, 181 (170-188); hind foot, 55. *Skull*: Average of 4 adult females: Greatest length, 54.2 (53.2-55.3); palatilar length, 26.1 (25-27); zygomatic breadth, 32.9 (32.3-34.5); cranial breadth, 22.9 (22.6-23.5); inter-orbital breadth, 12.2 (11.4-14); postorbital constriction, 16.1 (15.7-16.4); length of nasals, 18.9 (18.5-19.4); maxillary tooth row 11.2 (10.8-11.6).

*Remarks*.—This pale subspecies is similar in color to *parvulus* of California; its range is a desert area in Baja California between the ranges of *nudipes* and *C. atricapillus*, both of which are darker in color. No males of this race have been examined and only four females, so that the skull characters and color variations are imperfectly known.

*Specimens examined*.—Total number, 4, as follows:

Baja California: Catavina, 3; <sup>67</sup> San Fernando, 1.

#### CITELLUS BEECHEYI NESIOTICUS ELLIOT

##### CATALINA GROUND SQUIRREL

*Citellus nesioticus* Elliot, Field Columb. Mus. Pub., Zool. Ser. 3: 263, Mar. 8, 1904.

*Citellus beecheyi nesioticus* Grinnell, Calif. Acad. Sci. Proc. (4) 3: 345, 1913.

*Otospermophilus nesioticus* Miller, U. S. Natl. Mus. Bull. 128: 181, 1924.

*Type*.—Collected on Santa Catalina Island, Calif., February 8, 1903, by John Rowley; male adult, skin and skull, no. 11722, Field Mus. Nat. Hist.

*Range*.—Catalina Island, Calif. (fig. 14). *Zonal range*: Upper Sonoran.

*External characters*.—Similar to *C. b. beecheyi*, but hind foot averaging larger; coloration very similar, but averaging more grayish (less brownish) and light shoulder stripes less conspicuous.

<sup>67</sup> San Diego Soc. Nat. Hist.

*Cranial characters.*—Skull similar to that of *beecheyi*, but averaging larger; nasal branches of premaxillae broader.

*Color.*—*Winter pelage* (February–April): Head and face pinkish cinnamon or grayish white, more or less darkened when worn by the fuscous bases of the hairs; ears fuscous, broadly bordered on posterior portion with drab; upper parts mixed cinnamon buff and buffy white, darkened by the fuscous bases of the hairs; shoulders washed with grayish or buffy white, this wash continuing as an indistinct stripe on each side of the dorsal area to the middle of the body; sides flecked with rather large, irregular spots of white or buffy white; tail above, fuscous or fuscous black, mixed with buffy white; tail beneath, pinkish buff, mixed with fuscous black and edged with pale buff; feet cartridge buff; under parts pinkish buff or warm buff.

*Variation.*—The type specimen has a large patch of black on the forehead, this being the only specimen in the series of 18 examined that shows such a marking. Certain specimens in worn winter pelage show a large area of fuscous on the back from the occiput to the middle of the body.

*Measurements.*—Average of 12 adults (4 males, 8 females) from Catalina Island: Total length, 451 (432–476); tail vertebrae, 172 (154–188); hind foot, 59.1 (55–63.5); ear from notch (dry), 20.3 (19–21.8). *Skull:* Average of 4 adult males from Catalina Island: Greatest length, 60.7 (59.1–61.9); palatilar length, 29.2 (28–30); zygomatic breadth, 38.5 (36.8–40.1); cranial breadth, 24.5 (23.5–25.4); interorbital breadth, 15.5 (14.9–16); postorbital constriction, 15.2 (14.7–15.8); length of nasals, 22.6 (21.7–23.5); maxillary tooth row, 11.9 (11.8–12). Average of 11 adult females from same locality: Greatest length, 58 (56.9–60.3); palatilar length, 27.2 (26–28); zygomatic breadth, 36.4 (35–37.5); cranial breadth, 23.7 (22.9–24.4); interorbital breadth, 14.5 (13.5–15.9); postorbital constriction, 15.3 (14.6–16.2); length of nasals, 21.2 (20.6–22); maxillary tooth row, 11.7 (11.2–12.2).

*Remarks.*—This island form is evidently derived from the stock of the adjacent mainland, from which it has diverged but slightly. Since there is complete intergradation of characters between *nesioticus* and *beecheyi*, and certain specimens from the two series are practically identical, the island form is treated as a subspecies.

*Specimens examined.*—Total number, 18, from Catalina Island.

#### CITELLUS ATRICAPILLUS (BRYANT)

##### LOWER CALIFORNIA ROCK SQUIRREL

*Spermophilus grammurus atricapillus* Bryant, Calif. Acad. Sci. Proc. (2) 2: 26, June 20, 1889.

[*Citellus variegatus*] *atricapillus* Elliot, Field Columb. Mus. Pub., Zool. Ser. 4: 150, 1904.

*Otospermophilus grammurus atricapillus* Miller, U. S. Natl. Mus. Bull. 128: 180, 1924.

*Type.*—None designated; based on 29 specimens from Comondú, Baja California, formerly in the collection of the California Academy of Sciences, but destroyed by fire in 1906.

*Range.*—Southern Baja California, from the Sierra de San Francisco (Lat. 28°) south to Comondú (and possibly farther) (fig. 13). *Zonal range:* Lower Sonoran.

*External characters.*—Similar to *C. beecheyi beecheyi* but darker, especially on the head and anterior half of the back; tail averaging longer.

*Cranial characters.*—Skull similar to that of *beecheyi*, but averaging slightly smaller.

*Color.*—(Topotypes, winter pelage): Head fuscous black, sparingly sprinkled with pinkish buff; eye ring buffy white; ears fuscous black, narrowly margined on posterior border with pale buff; anterior half of back fuscous black, the sides of neck and shoulders tipped with buffy white, leaving a well defined dark triangular patch uniting with the color of the head; hairs on posterior back fuscous at base, tipped with pinkish cinnamon and pale pinkish buff; front feet pale buff; hind feet pinkish buff; tail mixed fuscous black and pale buff; under parts fuscous, overlaid with pale buff.

*Molt.*—A specimen from Comondú, September 27, had nearly completed the molt. New pelage had apparently come in from both directions, covering all the body except a small area just behind the shoulders. A female from San Ignacio, October 15, shows new pelage covering the posterior portion of the body almost to the shoulders.

*Measurements.*—Average of 12 adults (7 males, 5 females) from type locality: Total length, 440.4 (410–465); tail vertebrae, 195 (185–210); hind foot, 57.2 (55–60); ear from notch (dry), 17.5, 18 (2 specimens). *Skull:* Average of 9 adults (5 males, 4 females) from type locality: Greatest length, 56.3 (54.8–58.5); Palatilar length, 27 (26–28.5); zygomatic breadth, 34.5 (33.1–35.7); cranial breadth, 23.5 (22.6–24.6); interorbital breadth, 13 (12–14); postorbital constriction, 16 (15.1–17); length of nasals, 20.2 (19.1–21); maxillary tooth row, 11.5 (11–12).

*Remarks.*—Although closely related to *C. beecheyi*, *C. atricapillus* seems to be a distinct species, distinguished by darker coloration of the head and anterior back. The ranges of the two species are apparently separated by an area of low country about 40 miles in width, where squirrels of this group do not occur. Furthermore, the race of *beecheyi* occurring nearest to the range of *atricapillus* is very much paler (less blackish) and decidedly smaller.

*Specimens examined.*—Total number, 38, as follows:

Baja California: Comondú, 22; San Ignacio, 15; <sup>68</sup> San Pablo, 11.

#### NOTOCITELLUS, subgenus nov.

[Characters and description on p. 44]

##### KEY TO SPECIES AND SUBSPECIES

a<sup>1</sup>. Cheeks tawny.

b<sup>1</sup>. Under parts darker-----*annulatus* (p. 163)

b<sup>2</sup>. Under parts paler-----*goldmani* (p. 164)

a<sup>2</sup>. Cheeks buffy-----*adocetus* (p. 165)

#### CITELLUS ANNULATUS (AUDUBON AND BACHMAN)

[Synonymy under subspecies]

*Specific characters.*—Size medium, slightly smaller than *C. beecheyi*; hind foot, 50–64 mm; tail, 186–228; skull length, 51.6–57. Skull similar in general to that of *beecheyi*, but relatively narrower across the zygomata, which are less widely expanded at posterior end; interorbital breadth relatively greater; upper incisors shorter and thicker (antero-posterior diameter greater).

<sup>68</sup> Eight in collection San Diego Soc. Nat. Hist.

General form similar to that of *C. beecheyi beecheyi* but somewhat slenderer; ears broader and less pointed; feet and legs slenderer; claws on front feet sharper and more curved; tail nearly or quite as long as the body, distichous, rather narrow, and not bushy, annulated with about 15 blackish bands.

CITELLUS ANNULATUS ANNULATUS (AUDUBON AND BACHMAN)

RING-TAILED GROUND SQUIRREL

(Pls. 9; 26, *D*; 31, *D*)

*Spermophilus annulatus* Audubon and Bachman, Jour. Acad. Nat. Sci. Phila. 8: 319, 1842.

*Citellus annulatus* Merriam, Biol. Soc. Wash. Proc. 16: 79, 1903.

*Otospermophilus annulatus* Miller, U. S. Natl. Mus. Bull. 128: 180, 1924.

*Type*.—Not designated by number; the type specimen, without assigned locality, was purchased from a dealer by S. F. Baird and presented to Audubon (Baird, 1857, p. 327); type locality hereby fixed at Manzanillo, Colima, Mexico.

*Range*.—Colima and northern Guerrero, Mexico; probably also coastal region of Michoacan (fig. 15). *Zonal range*: Entirely Tropical.

*Characters*.—As given under specific characters. Skulls of females average larger than those of males.

*Color*.—Upper parts, including head, nearly uniform mixed fuscous black and cinnamon buff or pale pinkish buff, the blackish color often predominating on the head and sometimes on portions of the back; chin, throat, and sides of nose and face ochraceous buff; sides of neck, shoulders, and fore limbs hazel; ears and hind legs hazel or tawny; under parts warm buff or pinkish buff; tail above, mixed pinkish buff and black; tail beneath, hazel.

*Measurements*.—Average of 8 adult males from Manzanillo, Colima: Total length, 439 (410–470); tail vertebrae, 213.4 (187–228); hind foot, 58 (54–64); ear from notch (dry), 14.9 (14–16). Average of 9 adult females from Manzanillo: Total length, 433.5 (390–470); tail vertebrae, 216.4 (193–238); hind foot, 57.1 (54–60); ear from notch (dry), 15.4 (14–18). *Skull*: Average of 7 adult males from Manzanillo: Greatest length, 53.6 (51.6–55.8); palatilar length, 25.2 (24–26.4); zygomatic breadth, 30.5 (28.5–32.2); cranial breadth,

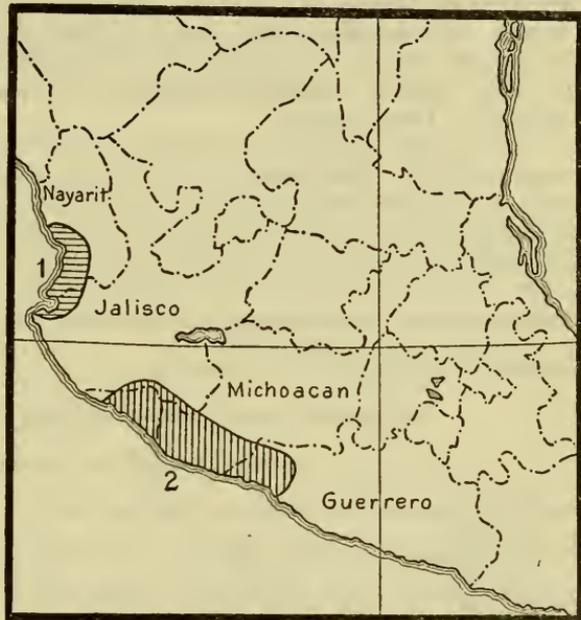


FIGURE 15.—Distribution of the subspecies of *Citellus annulatus*: 1, *C. a. goldmani*; 2, *C. a. annulatus*.

21.8 (21.2–22.8); interorbital breadth, 13.7 (13.3–15.2); postorbital constriction, 14.4 (13.9–14.9); length of nasals, 17.8 (15.9–19.3); maxillary tooth row, 10 (9.6–10.3). Average of 5 adult females from Manzanillo: Greatest length, 55.4 (54–57); palatilar length, 25.5 (25–26.2); zygomatic breadth, 31.2 (30.4–32.6); cranial breadth, 22.1 (21.1–23); interorbital breadth, 14.5 (13.6–15.3); postorbital constriction, 14.3 (13.3–14.8); length of nasals, 18.3 (18–18.8); maxillary tooth row, 9.9 (9.5–10.2).

*Remarks.*—The original specimen on which the species was based was purchased from a dealer and was supposed to have come from the “western prairies” (Audubon and Bachman, 1851, p. 215). Baird (1857, p. 327), however, considered it to be an African species of *Sciurus* and therefore eliminated it from the list of North American mammals. Allen (1877, p. 886), having seen a skin taken by Xantus on the plains of Colima, restored the species to the North American list, assuming (in the absence of a skull) that it belonged in the subgenus *Otospermophilus*. Both Bachman and Allen noted the resemblance of this animal in some of its characters to the tree squirrels (*Sciurus*). E. W. Nelson and E. A. Goldman, on their first trip to Mexico in 1892, obtained 26 specimens in the State of Colima, and this fine series has provided the material necessary for the present study of the species. This species and *C. adocetus* are the only ground squirrels, excepting *C. insularis*, that are strictly tropical in their range.

The original description differs in some details from the specimens in hand. Bachman says: “On the under parts, the chin, throat, belly, and inner surface of the legs and thighs are white”, whereas all the specimens examined have these parts ochraceous buff or warm buff, except that in a few the belly is buffy white.

*Specimens examined.*—Total number, 30, as follows:

Colima: Armeria, 2; Colima, 3; Hacienda San Antonio (at base of Volcano of Colima), 1; Manzanillo, 20.

Guerrero: El Naranjo, 3; La Union, 1.

#### CITELLUS ANNULATUS GOLDMANI (MERRIAM)

##### GOLDMAN'S GROUND SQUIRREL

*Spermophilus annulatus goldmani* Merriam, Biol. Soc. Wash. Proc. 15: 69, Mar. 22, 1902.

*Citellus annulatus goldmani* Miller and Rehn, Boston Soc. Nat. Hist. Proc. 31: 74, 1903.

*Otospermophilus annulatus goldmani* Miller, U. S. Natl. Mus. Bull. 128: 180, 1924.

*Type.*—Collected at Santiago, Nayarit, Mexico, June 18, 1897, by E. W. Nelson and E. A. Goldman; female adult, skin and skull, no. 91259, U. S. Natl. Mus. (Biological Survey collection) (orig. no. 11223).

*Range.*—Known at present only from the southern part of the State of Nayarit on the west coast of Mexico (fig. 15). *Zonal range:* Tropical.

*External characters.*—Similar to typical *C. a. annulatus*, but hind foot shorter; upper parts averaging darker (more blackish) and under parts paler; tawny color on sides of head and neck paler and less extensive; hind legs less tawny and more mixed with blackish.

*Cranial characters.*—Skull closely similar to that of *annulatus*.

*Color*.—Upper parts fuscous black, sprinkled with ochraceous buff; sides of head and neck, and fore limbs ochraceous tawny; sides of body warm buff, mixed with fuscous black; hind limbs tawny above, the thighs mixed with fuscous black; throat and under side of hind limbs ochraceous buff; belly pale pinkish buff; tail beneath, tawny; above, as in *annulatus*.

*Measurements*.—Average of 6 adult females from Nayarit: Total length, 415 (383–430); tail vertebrae, 204 (186–216); hind foot, 51.7 (50–54); ear from notch, 15.2 (14.5–15.5). *Skull*: Average of 5 adult females from Nayarit: Greatest length, 53.5 (51.9–55.4); palatilar length, 25 (24–26); zygomatic breadth, 30.4 (29–32.1); cranial breadth, 22.2 (21.6–23.1); interorbital breadth, 13.5 (13–14.1); postorbital constriction, 15.2 (14.5–15.8); length of nasals, 17.5 (16.8–18.5); maxillary tooth row, 9.7 (9.3–10.1).

*Remarks*.—Goldman's ground squirrel is a slightly darker race of *C. annulatus*, occupying an area to the northward of the typical subspecies.

*Specimens examined*.—Total number, 6, as follows:

**Nayarit**: Arroyo de Juan Sanches (about 40 miles southwest of Compostela), 1; Compostela, 1; San Blas, 2; Santiago, 2.

CITELLUS ADOCETUS MERRIAM

LESSER TROPICAL GROUND SQUIRREL

(Pls. 27, E; 32, E)

*Citellus adocetus* Merriam, Biol. Soc. Wash. Proc. 16: 79, May 29, 1903.  
*Otospermophilus adocetus* Miller, U. S. Natl. Mus. Bull. 128: 179, 1924.

*Type*.—Collected at La Salada, 40 miles south of Uruapan, Michoacan, Mexico, March 17, 1903, by E. W. Nelson and E. A. Goldman; female adult, skin and skull, no. 126129, U. S. Natl. Mus. (Biological Survey collection) (orig. no. 16183).

*Range*.—Southern Michoacan and northern Guerrero (fig. 16). *Zonal range*: Tropical.

*External characters*.—Similar to *C. annulatus* but smaller and paler (less reddish); tail without annulations.

*Cranial characters*.—Skull similar in shape and dentition to that of *annulatus* but much smaller; rostrum shorter and broader; interorbital region relatively broader; variation in size is considerable; the largest skull in the series is of a female.

*Color*.—*Worn pelage* (March): Hairs on upper parts fuscous at base, tipped with pale pinkish buff or cream color; sides of head and



FIGURE 16.—Distribution of *Citellus adocetus*.

neck irregularly blotched with ochraceous tawny; front legs pinkish buff or cinnamon buff; hind feet cinnamon buff, the thighs ochraceous tawny; tail fuscous or fuscous black, mixed with pale pinkish buff or buffy white, the hairs showing three dark bands when viewed from beneath, but without annulations above; under side of tail shaded with ochraceous tawny toward the tip; under parts pinkish buff or warm buff.

*Measurements.*—Average of 14 adults (10 males, 4 females) from type locality: Total length, 335.3 (315–353); tail vertebrae, 154.6 (138–168); hind foot, 46.4 (43–48); ear from notch, 14 (13–15). *Skull:* Average of 11 adults and subadults (6 males, 5 females): Greatest length, 43.6 (41.6–46.2); palatilar length, 20.4 (19–22); zygomatic breadth, 24.6 (23.1–26.2); cranial breadth, 19.2 (18.3–20.1); interorbital breadth, 11.9 (11.5–13.8); postorbital constriction, 13.4 (12.6–14.3); length of nasals, 13.5 (11.1–14.7); maxillary tooth row, 8.7 (7.7–9.2).

*Remarks.*—This ground squirrel, although clearly rather closely related to *annulatus*, differs from it in many important characters of both skin and skull. It occupies a somewhat more arid district, farther from the coast than does *annulatus*. The ranges of the two nearly meet and possibly overlap in northern Guerrero. Like *annulatus*, the range of this species is entirely within the Tropics.

*Specimens examined.*—Total number, 36, as follows:

**Guerrero:** La Escondida (about 20 miles southeast of Balsas), 1.  
**Michoacan:** La Huacana, 2; La Salada, 32; Volcan Jarullo, 1.

#### Subgenus AMMOSPERMOPHILUS Merriam

[Cranial characters on p. 44]

#### EXTERNAL CHARACTERS

Upper parts nearly uniform, varying from pinkish buff, vinaceous buff, pinkish cinnamon, or vinaceous cinnamon, to wood brown, army brown, fawn, drab gray, or mouse gray; a narrow, white longitudinal line on each side of the back, from the shoulders to the rump; tail above, mixed black and white, similar beneath, or with a broad white or buffy median area.

#### PELAGE AND MOLT

The winter pelage is dense and soft, the summer pelage shorter and more wiry. The bases of the hairs are plumbeous, succeeded by a rather broad whitish or buffy area, then a narrow brownish area, and tipped with white, or varying shades of buff, cinnamon, and gray.

The squirrels of this group have two molts annually; the spring molt takes place between the middle of April and early July—usually in May or June—and begins ordinarily on the head and shoulders, but sometimes in patches all over the back. The fall molt occurs from about the middle of September to the last of October, and proceeds from the rump and flanks forward. Several specimens of *Citellus leucurus peninsulæ* from Baja California are unusual in having a fresh pelage coming in on the hinder parts, between August 8 and 23.

## KEY TO SPECIES AND SUBSPECIES

- a.*<sup>1</sup> Under side of tail with median area white.
- b.*<sup>1</sup> Tail hairs with two black bands.
- c.*<sup>1</sup> Upper parts more buffy (pinkish buff to wood brown)--- *nelsoni* (p. 182)
- c.*<sup>2</sup> Upper parts less buffy (vinaceous cinnamon to army brown or drab gray).
- d.*<sup>1</sup> Upper parts drab gray----- *interpres* (p. 180)
- d.*<sup>2</sup> Upper parts not drab gray.
- e.*<sup>1</sup> Anterior upper premolar absent or rudimentary. *insularis* (p. 181)
- e.*<sup>2</sup> Anterior upper premolar present.
- f.*<sup>1</sup> Smaller and paler----- *canfieldae* (p. 178)
- f.*<sup>2</sup> Larger and darker.
- g.*<sup>1</sup> Rump and thighs army brown----- *peninsulæ* (p. 176)
- g.*<sup>2</sup> Rump and thighs vinaceous cinnamon----- *extimus* (p. 179)
- b.*<sup>2</sup> Tail hairs with one black band.
- c.*<sup>1</sup> General tone of upper parts vinaceous cinnamon.
- d.*<sup>1</sup> Upper parts light vinaceous cinnamon----- *pennipes* (p. 175)
- d.*<sup>2</sup> Upper parts vinaceous cinnamon.
- e.*<sup>1</sup> Back darkened with fuscous----- *tersus* (p. 173)
- e.*<sup>2</sup> Back not darkened with fuscous----- *cinnamomeus* (p. 174)
- c.*<sup>2</sup> General tone of upper parts pinkish buff----- *leucurus* (p. 170)
- a.*<sup>2</sup> Under side of tail without median white area.
- b.*<sup>1</sup> Colors darker----- *harrisii* (p. 167)
- b.*<sup>2</sup> Colors paler----- *saxicola* (p. 169)

## CITELLUS HARRISII (AUDUBON AND BACHMAN)

[Synonymy under subspecies]

*Specific characters.*—Size about as in the larger races of *C. leucurus*, but tail averaging longer, 74–94 mm; hind foot, 38–42; skull length, 38.2–41.2. Skull closely similar to that of *C. leucurus cinnamomeus*. Upper parts in summer pinkish cinnamon, more or less darkened with fuscous; in winter, mouse gray; tail above and below, mixed black and white (lacking the clear white under surface of *leucurus*).

## CITELLUS HARRISII HARRISII (AUDUBON AND BACHMAN)

GRAY-TAILED ANTELOPE SQUIRREL

(Pl. 10)

*Spermophilus harrisii* Audubon and Bachman, Quad. North Amer. 3: 267, 1854.

*Tamias harrisii* Merriam, North Amer. Fauna 2: 19, 1889.

*Anisonyx (Ammospermophilus) harrisii* Allen, Amer. Mus. Nat. Hist. Bull. 7: 240, 1895.

[*Citellus*] *harrisii* Elliot, Field Columb. Mus. Pub., Zool. Ser. 4: 141, 1904.

*Ammospermophilus harrisii* Mearns, U. S. Natl. Mus. Bull. 56: 303, 1907.

*Type.*—None designated; description based on a specimen presented to Audubon by Edward Harris, supposed to have been collected by John K. Townsend, but locality unknown. The type locality is hereby fixed in the Santa Cruz Valley, Ariz., at the Mexican boundary line.<sup>68a</sup>

*Range.*—Greater part of southern, central, and northwestern Arizona; north to the Colorado River, west of longitude 113°; east to southwestern New Mexico (Hidalgo County); south to southern Sonora (Ortiz); west to Quitobaquito, on the Mexican boundary line (fig. 17). *Zonal range:* Lower Sonoran.

<sup>68a</sup> Mearns (1896, p. 444), in describing the subspecies *saxicola*, restricted the name *harrisii* "to the darker form, which was found in the Elevated Central Tract, along the Mexican boundary line, from the Santa Cruz Valley westward as far as the Sonoyta \* \* \*."

*External characters.*—Similar to *C. leucurus leucurus* but larger and slightly darker; tail longer and darker, the under surface mixed black and white (never clear white). Compared with *C. l. cinnamomeus*: Coloration in winter pelage much more grayish (less vinaceous); in summer pelage darker and less vinaceous; tail longer and darker beneath.

*Cranial characters.*—Skull similar to that of *leucurus* and of *cinnamomeus*, but averaging larger.

*Color.*—*Winter pelage:* General tone of upper parts mouse gray, the hairs fuscous subterminally, conspicuously tipped with white; head and face vinaceous buff or fawn color; shoulders and thighs vinaceous fawn; front legs and feet vinaceous cinnamon; hind feet light vinaceous cinnamon, the toes pinkish buff; tail above and below, mixed black and white, the hairs with a broad subterminal band of black and a narrower black band near the base. *Summer pelage:* Upper parts nearly uniform light pinkish cinnamon, clearest on the shoulders and thighs, somewhat darkened with fuscous on the back.

*Molt.*—The spring molt occurs in May; specimens taken May 13, 16, and 19, respectively, are in badly worn condition, with new hair occurring in patches all over the body.



FIGURE 17.—Distribution of *Citellus interpres*, *C. insularis*, and *C. nelsoni* and of the subspecies of *C. leucurus* and *C. harrisi* (subgenus *Ammospermophilus*): 1, *C. l. leucurus*; 2, *C. l. pennipes*; 3, *C. l. cinnamomeus*; 4, *C. l. tersus*; 5, *C. l. peninsularis*; 6, *C. l. canfieldae*; 7, *C. l. eximius*; 8, *C. insularis*; 9, *C. h. sawicola*; 10, *C. h. harrisi*; 11, *C. insularis*; 12, *C. nelsoni*.

*Measurements.*—Average of 12 adults (9 males, 3 females) from Tucson and Oracle, Ariz.: Total length, 233.8 (225–250); tail vertebrae, 82.7 (74–94); hind foot, 39.7 (38–42). *Skull:* Average of 8 adult males from Tucson and Santa Rita Mountains: Greatest length, 40 (38.8–41.2); palatilar length, 18.3 (17–19); zygomatic breadth, 23.4 (22.8–24.7); cranial breadth, 19.1 (18.6–19.5); interorbital breadth, 9.9 (9–10.8); postorbital constriction, 14.4 (13.9–14.9); length of nasals, 13.1 (12–13.5); maxillary tooth row, 7.2 (6.8–7.5). Average of 7 adult females from Tucson, Phoenix, and Roosevelt Lake: Greatest length, 39.4 (38.4–39.9); palatilar length, 18.1 (18–18.5); zygomatic breadth, 23 (22.1–23.7); cranial breadth, 19 (18.5–19.8); interorbital breadth, 9.8 (9.4–10.5); postorbital constriction, 13.7 (13.1–14.5); length of nasals, 12 (11.5–12.7); maxillary tooth row, 7.4 (7–7.8).

*Weight.*—Three specimens weighed, respectively, 112, 122, and 139 g.

*Remarks.*—Described by Audubon and Bachman in 1854, this remained the only recognized species of the group until 1889, when Merriam separated *leucurus*, which up to that time had been confused with *harrisii*. It seems remarkable that a species so distinct as this should occupy an area in the middle of the range of the group, and separated from its congeners by no seemingly effective barriers, at least to the eastward. No reason is apparent why either *harrisii* or *C. interpres* should not occupy southwestern New Mexico, but so far as known, there is a considerable gap in that region between the ranges of these two species. On the west and north, the Colorado River with its deep canyon has proved to be effective in separating the ranges of *harrisii* and *leucurus*.

*Specimens examined.*—Total number 217, as follows:

**Arizona:** Baboquivari Mountains, 1; Beale Spring (near Kingman), 6; Big Sandy Creek (Mohave County), 5; Camp Verde (Yavapai County), 16; Congress Junction, 7; Coyote Mountains (Pima County), 1; Dolan Spring (12 miles northwest of Chloride), 14; Fish Creek (Maricopa County), 4; Fort Bowie, 9; Fort Mohave, 5; Gila Mountains (Graham County), 2; Graham Mountains (Pinaleno Range), 1; Gold Basin (Mohave County), 3; Gold Road (Mohave County), 3;<sup>69</sup> Hackberry (Mohave County), 1; Harquahala Mountains, 1; H-Bar Ranch (Gila County, 10 miles south of Payson), 2; Indian Oasis (Pima County), 1; Kingman, 3;<sup>70</sup> Kirkland (Yavapai County), 4; Klondyke (Graham County), 2; La Oso (Pima County), 1; Little Meadows (east side Black Mountains, Mohave County), 6; Mammoth (Pinal County), 1; Maricopa County (20 miles southwest of Phoenix), 2;<sup>71</sup> McMillenville (Gila County), 1; Mineral Park (Mohave County), 4; Montezuma Well (Yavapai County), 4; Mud Spring (18 miles northwest of Kingman), 7; New River (Maricopa County), 4; Oatman, 1;<sup>70</sup> Old Searchlight Ferry, Colorado River, 1; Oracle (Pinal County), 15; Peach Springs (Mohave County), 3; Phoenix, 7; Pima County (30 miles south of Tucson), 14;<sup>71</sup> Quitobaquito (Pima County), 5; Rice (Gila County), 1; Roosevelt (17 miles east), 1; Roosevelt Lake, 3; Salt River (12 miles north of McMillenville), 1; Salt River Mountains, 2;<sup>72</sup> Santa Catalina Mountains (mouth of Bear Canyon), 2; Santa Rita Mountains (north base), 4; Sheldon (Greenlee County), 2; Superior, 2; Tucson, 16; Turkey Creek (east base of Bradshaw Mountains, Yavapai County), 5; Vail (Pima County), 2;<sup>69</sup> Vulture (20 miles southwest of Wickenburg), 1; Wickenburg, 1.

**New Mexico:** Animas (12 miles northwest, Grant County), 1.

**Sonora:** Hermosillo, 1; Magdalena, 3; Ortiz, 1; Poso de Luis (5 miles south of Monument 152), 1.

#### CITELLUS HARRISII SAXICOLA (MEARNS)

##### YUMA ANTELOPE SQUIRREL

*Spermophilus harrisii saxicolus* Mearns, U. S. Natl. Mus. Proc. 18: 444, May 23, 1896 (advance sheet published March 25, 1896).

[*Citellus (Spermophilus) harrisii saxicola* Elliot, Field Columb. Mus. Pub., Zool. Ser. 4: 142, 1904.

*Ammospermophilus harrisii saxicola* (Mearns), U. S. Natl. Mus. Bull. 56: February 1907.

*Ammospermophilus harrisii kinoensis* Huey, San Diego Zool. Soc. Trans. 18: 352, 1937 (Bahia Kino, Sonora, Mexico). . . postorbital constriction, 13.9

*Type.*—Collected at T. . . maxillary tooth row, 6.7 (6.1-7).

Ariz., February 16, 1897; extensive range this race shows relatively and skull, no. 59869, U. S. from southeastern Oregon appears slightly from the type region, but the differences are

<sup>69</sup> Cleveland Mus. Nat. Hist., n by name. Intergradation with *C. l. cinna-*  
<sup>70</sup> Univ. Michigan Mus. Zool.  
<sup>71</sup> Kansas Univ. Mus. Natl.  
<sup>72</sup> Field Mus. Nat. Hist., of eight specimens from St. George, Utah, some are like typical *leucurus* and others almost like

*Range.*—Southwestern Arizona and northwestern Sonora, from the Colorado River east to about longitude 113° (fig. 17). *Zonal range.*: Lower Sonoran.

*External characters.*—Closely similar to *C. h. harrisii* but averaging paler on the head, back, shoulders, and thighs.

*Cranial characters.*—Skull very similar to that of *harrisii* but averaging slightly smaller.

*Color.*—*Winter pelage.*: General tone of upper parts smoke gray, varying to light cinnamon drab, the hairs conspicuously tipped with white; head, face, shoulders, and thighs vinaceous buff; otherwise as in *harrisii*. *Summer pelage.*: General tone of upper parts vinaceous fawn, somewhat darkened by the fuscous bases of the hairs, the white tips mostly worn off.

*Measurements.*—Average of 11 adults (6 males, 5 females) from type locality: Total length, 234 (222–245); tail vertebrae, 86.2 (81–92); hind foot, 39.3 (38–41). *Skull.*: Average of 12 adults (8 males, 4 females) from type locality: Greatest length, 39.4 (38.2–40.3); palatilar length, 17.8 (16.5–18.8); zygomatic breadth, 23 (22.3–23.6); cranial breadth, 18.9 (18.6–19.3); interorbital breadth, 9.6 (9.1–10.7); postorbital constriction, 13.7 (12.4–14.2); length of nasals, 12.4 (11.3–13.8); maxillary tooth row, 6.9 (6.6–7.5).

*Specimens examined.*—Total number 65, as follows:

Arizona: Ajo (10 miles north, Pima County), 6; Castle Dome (Yuma County), 2; Gila Mountains (Yuma County), 1; Granite Mountains (near Monument 187), 2; Parker (Yuma County), 5; Quartzsite (Yuma County), 1; Tinajas Altas (Yuma County), 15; Tule Wells (Yuma County), 3; Vicksburg (Yuma County), 6; Yuma, 12.  
Sonora: Bahia Kino, 6; <sup>72a</sup>Porto Libertad, 6.<sup>72a</sup>

#### CITELLUS LEUCURUS (MERRIAM)

[Synonymy under subspecies]

*Specific characters.*—Size of *C. harrisii* or somewhat smaller; hind foot, 35–43 mm; tail, 54–87; skull length, 37–41.8. Skull essentially like that of *harrisii*, but smaller in some races. General tone of upper parts varying in summer pelage from pinkish cinnamon or vinaceous cinnamon to cinnamon drab, fawn color, or army brown, the hairs more or less tipped with white or buffy white; in winter pelage more grayish, drab gray or mouse gray; tail broadly white or whitish below, bordered with fuscous black.

#### CITELLUS LEUCURUS LEUCURUS (MERRIAM)

WHITE-TAILED ANTELOPE SQUIRREL

(Pls. 10; 27, F; 32, E)

*Orac.*, *philus harrisii* Baird, Mamm. North Amer., p. 313, 1857 (not of Audubon foot, 39.7).  
Rita Mountains: Greatest length, 39.4 (38.2–40.3); palatilar length, 17.8 (16.5–18.8); zygomatic breadth, 23.4 (22.8–23.6); cranial breadth, 18.9 (18.6–19.3); interorbital breadth, 9.9 (9–10.8); postorbital constriction, 13.7 (12.4–14.2); length of nasals, 13.1 (12–13.5); maxillary tooth row, 7.2 (6.6–7.5).  
females from Tucson, Phoenix, and Roosevelt (Bachman), Proc. 7: 27, 1892.  
(38.4–39.9); palatilar length, 18.1 (18–18.5); zygomatic tooth row, Ser. 3: 210, 1903.  
cranial breadth, 19 (18.5–19.8); interorbital breadth, Zool. Ser. 3: 241, 1903  
bital constriction, 13.7 (13.1–14.5); length of nasal tooth row, Bull. 56: 299, 1907.  
tooth row, 7.4 (7–7.8).

*Weight.*—Three specimens weighed, respectively, 112.,

*Type*.—Collected in San Gorgonio Pass, Riverside County, Calif., May 16, 1885, by Frank Stephens; male adult, skin and skull, no. 186466, U. S. Natl. Mus. ( $\frac{11\frac{1}{2}}{8}$ , Merriam collection) (orig. no. 68).

*Range*.—Desert regions of southeastern Oregon, southwestern Idaho, Nevada, western Utah, southeastern California, and northeastern Baja California; north to northern Malheur County, Oreg., and the Snake River Valley, Idaho; east to the Sevier River Valley, Utah; south to San Felipe Bay, Baja California; west to the Mohave Desert, Calif. (fig. 17). *Zonal range*: Upper and Lower Sonoran.

*External characters*.—Similar in color to *C. harrisi harrisi* but upper parts and limbs paler, especially in winter pelage; tail shorter and pure white instead of grizzled gray beneath.

*Cranial characters*.—Skull closely similar to that of *harrisi* but averaging slightly smaller.

*Color*.—*Summer pelage*: Head and upper parts vinaceous buff; eye ring and lateral stripes white; front and hind limbs light pinkish cinnamon, shading to buffy white on the feet; tail above, mixed black and white, except at the base, where it is like the body color; tail beneath, clear creamy white, with a subterminal band of black on the sides and tip; under parts white or buffy white. *Winter pelage* (November): Hairs on median dorsal area white at the tips, with a subterminal band of fuscous, producing the general tone effect of drab gray or pale drab gray, shading to vinaceous buff on the head and fore legs; hind legs vinaceous cinnamon.

*Molt*.—The spring molt may begin as early as the middle of April or be deferred until July. A specimen taken in the Panamint Mountains, Calif., April 16, is in much worn pelage, but shows new pelage coming in on the head and fore back; one from Granite Creek, Nev., May 18, is in a similar condition of molt; two specimens from Cabazon, Calif., May 30 and June 2, show fresh pelage appearing in patches all over the upper parts from nose to root of tail. A female from Walker Pass, Calif., June 21, had just begun to molt on the head and fore back; a badly worn female specimen from the San Jacinto Mountains, Calif., July 6, shows new hair coming in in patches all over the body. The fall molt takes place in September or October, commencing on the tail and hinder part of body; a specimen from Whitewater, Calif., September 13, shows new winter pelage covering the posterior half of the body; one from Antelope Valley, Los Angeles County, Calif., October 17, had completed the fall molt except on the head.

*Measurements*.—Average of 10 adults (5 males, 5 females) from type locality: Total length, 216.3 (211–223); tail vertebrae, 67.5 (63–71); hind foot, 38.3 (37–40); ear from notch, 9 (8.5–10). *Skull*: Average of 11 adults (8 males, 3 females) from type locality: Greatest length, 38.8 (37.3–40); palatilar length, 17.6 (16.8–18.5); zygomatic breadth, 22.6 (21.7–23.5); cranial breadth, 18.4 (17.8–19.3); interorbital breadth, 9.7 (8.8–10.4); postorbital constriction, 13.9 (13.1–14.9); length of nasals, 11.4 (10.7–12); maxillary tooth row, 6.7 (6.1–7).

*Remarks*.—Over its very extensive range this race shows relatively little variation. A series from southeastern Oregon appears slightly darker than the series from the type region, but the differences are too slight for recognition by name. Intergradation with *C. l. cinna-momeus* takes place in southwestern Utah and the adjacent parts of Arizona. In a series of eight specimens from St. George, Utah, some of the specimens are like typical *leucurus* and others almost like

typical *cinnamomeus*. One from Canaan Spring, Utah, agrees in color with *leucurus*, but has a large skull like that of *cinnamomeus*.

This species was confused with *harrisii* by all writers prior to 1889, when Merriam pointed out its characters and named it.

*Specimens examined*.—Total number, 584, as follows:

- Arizona:** Beavertdam (=Littlefield, Mohave County), 1; Grand Wash (8 miles south of Pakoon Spring, Mohave County), 2; Wolf Hole (6 miles north, Mohave County), 2.
- Baja California:** San Felipe, 13;<sup>75 79</sup> San Felipe Bay, 1; San Pedro Martir Mountains, 4.
- California:** Amedee (Lassen County), 1; Antelope Valley (Los Angeles County), 1; Argus Mountains, 6; Banning, 4; Barstow, 17; Beckwith Pass (Lassen County), 2; Benton (Mono County), 1;<sup>73</sup> Bergmann's (25 miles east of Temecula, Riverside County), 1;<sup>74</sup> Bishop (8 miles west), 1; Borax Flat (San Bernardino County), 3; Cabazon (Riverside County), 29; Chuckawalla Spring (Riverside County), 1; Coast Range Mountains (east base, 5 miles north of Monument no. 230), 7; Colorado Desert, 1; Colorado River (opposite Parker, Ariz.), 5; Coso (Inyo County), 13; Coso Mountains, 2;<sup>75</sup> Daggett (San Bernardino County), 1; Darwin (Inyo County), 1;<sup>73</sup> Deep Spring Valley (Inyo County), 1; Emigrant Spring, Panamint Mountains, 1; Funeral Mountains, 1; Furnace Creek Ranch, Death Valley, 1; Goffs (San Bernardino County), 6; Granite Wells, Mohave Desert, 2; Hesperia (San Bernardino County), 1; Hodge (San Bernardino County), 1; Independence (Inyo County), 1;<sup>73</sup> Inyo Mountains, 7;<sup>73 75</sup> Ivanpah (San Bernardino County), 4; Jacumba (San Diego County), 1; Kearns Pass, 1;<sup>73</sup> Keeler, 6;<sup>73 75</sup> Kern River Valley (near Kernville), 1; Little Lake (Inyo County), 1;<sup>73</sup> Little Owens Lake, 1; Lone Pine, 8; Lone Willow Spring (San Bernardino County), 9; Long Valley (Lassen County), 1; Lower Alkali Lake (Modoc County), 2; Ludlow (San Bernardino County), 2; Mohave, 26; Mohave Desert, 7; Mountain Spring (4 miles north of Monument no. 231, San Diego County), 14; Needles, 11; Onyx (Kern County), 20; Oro Grande (San Bernardino County), 10; Owens Valley, 6; Owens Lake, 5; Palm Springs, 5; Panamint Mountains, 42; Panamint Valley, 4; Providence Mountains, 3; Rader (12 miles east of Temecula, Riverside County), 5; Resting Springs (Inyo County), 15; Saline Valley (Inyo County), 1; Salt Wells Valley (Death Valley), 2; San Felipe River (San Diego County), 4; San Felipe Canyon, 1; San Gorgonio Pass, 7; San Jacinto Mountains (Oak Valley), 1; Secret Valley (Lassen County), 2; Shoshone (Inyo County), 1;<sup>73</sup> Smoke Creek (at head, Lassen County), 1; Twelve Mile Spring (12 miles north of Resting Springs), 1; Vallecito (San Diego County), 2; Victorville, 3; Walker Pass (Kern County), 4; Weldon (Kern County), 1;<sup>73</sup> Whitewater (Riverside County), 4.
- Idaho:** Glens Ferry, 2; Murphy, 1.
- Nevada:** Alamo, Lincoln County, 1;<sup>73</sup> Ash Spring (Pahrangat Valley), 2;<sup>73</sup> Ash Meadows (Nye County), 18; Baker Creek (White Pine County), 2;<sup>73</sup> Black Canyon, Colorado River, 3; Blair (Esmeralda County), 1; Candelaria, 5;<sup>74</sup> Carson City, 1; Cedar Basin (Clark County), 2;<sup>80</sup> Charleston Mountains, 4; Cloverdale (6 miles south of Golden, Nye County), 2; Desert Valley (23 miles west of Panaca, Lincoln County), 1;<sup>73</sup> Elko County, 8 miles south of Wendover, Utah, 1;<sup>73</sup> Esmeralda County, 2;<sup>76</sup> Flowing Springs (Humboldt County), 2; Granite Creek (Washoe County), 7; Grapevine Mountains, 1; Groom Baldy (16 miles east, Lincoln County), 2;<sup>73</sup> Hot Creek Range (Nye County), 1;<sup>73</sup> Hot Creek Valley (Twin Spring), 1;<sup>73</sup> Imlay, 2; Lehman Cave (White Pine County), 1;<sup>73</sup> Little High Rock Canyon (Washoe County), 1;<sup>73</sup> Lund (White Pine County), 1;<sup>73</sup> Meadow Valley (24 miles south of Caliente), 1;<sup>73</sup> Millette, 3;<sup>73</sup> Nyala (Nye County), 1;<sup>73</sup> Oasis Valley (Nye County), 6; Osobb Valley (Churchill County), 1; Pahrangat Mountains (Lincoln County), 1; Pahrangat Valley, 5;<sup>73</sup> Pahroc Spring (Lincoln County), 1; Pahrump Valley (Nye County), 10; Pyramid Lake, 14; Quinn

<sup>73</sup> Mus. Vert. Zool.

<sup>74</sup> J. H. Fleming collection.

<sup>75</sup> Field Mus. Nat. Hist.

<sup>76</sup> Kansas Univ. Mus.

<sup>77</sup> San Diego Soc. Nat. Hist.

<sup>80</sup> California Inst. Tech.

Canyon Mountains, 1;<sup>73</sup> Raspberry Creek (near Cosgrave, Pershing County), 1; Reese River (Nye County), 1; St. Thomas, 1;<sup>80</sup> Sharp (Nye County), 4;<sup>73</sup> Silver Peak Mountains, 4; Spring Valley (White Pine County), 2;<sup>73</sup> Thorp Mill (east base Grapevine Mountains), 2; Timpahute Mountains, 1; Virgin Valley (Humboldt County), 1;<sup>73</sup> Virginia Mountains, 2; Vegas Valley (Lincoln County), 3; Wadsworth, 6; Washoe Lake, 1; White River Valley (Nye County), 1;<sup>73</sup> Winnemucca Lake, 10.

Oregon: Adel (Lake County), 4; Rome (Malheur County), 1; South Warner Lake, 1; Tumtum Lake, 6; Vale, 1; Warner Valley, 1; Watson (Malheur County), 10.

Utah: Canaan Spring (Washington County, near Arizona line), 1; Clear Creek (Sevier County), 1; Elberta (Utah County), 2;<sup>80a</sup> Escalante, 1;<sup>80a</sup> Fillmore, 1; Hebron (Washington County), 4; Junction (Piute County), 1; Marysvale, 2; Monroe, 2;<sup>77</sup> Nephi, 1; Parowan, 1;<sup>78</sup> Promontory Point (Box Elder County), 1; St. George, 9; Sevier River (10 miles south of Panguitch), 1; Toquerville, 2.

### CITELLUS LEUCURUS TERSUS (GOLDMAN)

#### GRAND CANYON ANTELOPE SQUIRREL

*Ammospermophilus leucurus tersus* Goldman, Jour. Wash. Acad. Sci. 19: 435, Nov. 19, 1929.

*Type*.—Collected in Prospect Valley, Grand Canyon, Hualpai Indian Reservation, Ariz. (4,500 feet altitude), October 3, 1913, by E. A. Goldman; male subadult, skin and skull, no. 202645, U. S. Natl. Mus. (Biological Survey collection) (orig. no. 22269).

*Range*.—Terraces on southern side of Grand Canyon, in the Hualpai Indian Reservation, Ariz. (fig. 17). *Zonal Range*: Upper Sonoran.

*External characters*.—Similar in size to *C. l. leucurus*, but upper parts darker (more brownish, less grayish), especially on the rump and lower back. Compared with *C. l. cinnamomeus*: Upper parts more brownish (less pinkish or cinnamon); size smaller.

*Cranial characters*.—Skull similar to that of *leucurus*, but averaging slightly smaller in length and zygomatic breadth; nasals about same length, but slightly narrower.

*Color*.—*Winter pelage*: Upper parts fawn color or army brown; shoulders and fore back heavily sprinkled with whitish hairs; hinder back, rump, and thighs darker; feet whitish, washed with light vinaceous cinnamon; under parts creamy white; tail as in *leucurus*. Full summer pelage not seen; in a worn specimen taken October 3 the head and fore back are pinkish cinnamon, the rest of the body in winter pelage.

*Molt*.—The fall molt occurs in late September; a specimen taken September 26 has acquired winter pelage over the entire body excepting the head; others taken October 3 still retain worn summer pelage on the anterior half of the body, the rest being in full winter pelage.

*Measurements*.—Average of 9 adults from type locality: Total length, 204 (194–214); tail vertebrae, 62 (54–72); hind foot, 39 (38–40); ear from notch, 8 (7–9). *Skull*: Average of 10 adults (5 males, 5 females); Greatest length, 37.5 (37–39.1); palatilar length, 17 (16.5–17.5); zygomatic breadth, 21.9 (21.3–22.6); cranial breadth, 18.5 (18–19); interorbital breadth, 9.3 (8.6–9.6); post-orbital constriction, 13.7 (13.3–14.3); length of nasals, 11.6 (11.2–12.5); maxillary tooth row, 6.7 (6.3–7.4).

<sup>73</sup> Mus. Vert. Zool.

<sup>77</sup> Utah State Agr. College.

<sup>78</sup> Cleveland Mus. Nat. Hist.

<sup>80</sup> California Inst. Tech.

<sup>80a</sup> Brigham Young Univ.

*Remarks.*—Goldman (1929, p. 435), has described the habitat of this race as follows:

In the Grand Canyon of the Colorado River, which bisects the high plateau region of northern Arizona, antelope squirrels are restricted mainly to the broader terraces bordering the inner gorge. These terraces are cut at frequent intervals by side canyons, some of which extend with sheer walls to the nearly or quite precipitous outer rim of the main canyon. The higher parts of the Coconino Plateau along Grand Canyon are unsuited to the needs of antelope squirrels and the side canyons mentioned, while not absolute barriers at their heads, evidently tend to break the continuity of range within the main canyon.

*Specimens examined.*—Total number, 10, from type locality.

CITELLUS LEUCURUS CINNAMOMEUS (MERRIAM)

RUSTY ANTELOPE SQUIRREL

*Tamias leucurus cinnamomeus* Merriam, North Amer. Fauna 3: 52, Sept. 11, 1890.

*Anisonyx (Ammospermophilus) leucurus cinnamomeus* Allen, Amer. Mus. Nat. Hist. Bull. 7: 240, 1895.

[*Spermophilus leucurus*] *cinnamomeus* Elliot, Field Columb. Mus. Pub., Zool. Ser. 2: 86, 1901.

*Citellus leucurus cinnamomeus* Elliot, Field Columb. Mus. Pub., Zool. Ser. 6: 97, 1905.

*Ammospermophilus leucurus cinnamomeus* Mearns, U. S. Natl. Mus. Bull. 56: 299, 1907.

*Type.*—Collected at Echo Cliffs, Painted Desert, Ariz., September 22, 1889, by C. Hart Merriam and Vernon Bailey; female subadult, skin and skull, no.  $\frac{7987}{4898}$ , U. S. Natl. Mus. (Biological Survey collection) (orig. no. 510).

*Range.*—Northeastern Arizona, southern Utah, and southwestern Colorado; north to Mount Carmel, Utah and Coventry, Colo.; south to Taylor, Ariz. (fig. 17). *Zonal range:* Mainly Upper Sonoran.

*External characters.*—Similar to *C. l. leucurus*, but coloration of upper parts darker and more reddish (less grayish); hind legs darker.

*Cranial characters.*—Skull similar to that of *leucurus* but averaging slightly larger, with longer nasals.

*Color.*—*Winter pelage:* General tone of upper parts vinaceous cinnamon, more or less darkened, especially on the hinder back and rump by mikado brown, which forms a subterminal band on most of the hairs; many of the hairs are tipped with white, most strongly on the fore back; sides of head and neck washed with fuscous; eye ring buffy white; lateral stripes creamy white; hind legs vinaceous cinnamon to army brown, the feet buffy white, washed with pinkish cinnamon; front legs similar, but paler; tail above, mixed black and white; tail beneath, creamy white, bordered with black; under parts white, washed with cartridge buff. *Summer pelage:* Upper parts nearly uniform vinaceous cinnamon; feet light vinaceous cinnamon; otherwise as in winter.

*Molt.*—A specimen from the Grand Canyon, Ariz., taken May 27, shows new pelage appearing on the head and nape; one from the Navajo Indian Reservation, June 14, had nearly completed the spring molt, new pelage covering all of the body except the rump and hind legs.

*Measurements.*—Average of 12 adults (7 males, 5 females) from the Painted Desert and Keams Canyon: Total length, 225.8 (215–238); tail vertebrae, 73 (64–79); hind foot, 40 (39–43). *Skull:* Average of 8 adults (4 males, 4 females) from the Painted Desert: Greatest length, 39.3 (38.9–39.7); palatilar length,

17.3 (16.5-18); zygomatic breadth, 23 (22-23.7); cranial breadth, 19.1 (18.5-19.7); interorbital breadth, 9.5 (9.3-9.8); postorbital constriction, 14.1 (13.6-14.5); length of nasals, 12.4 (11.9-13); maxillary tooth row, 7.2 (7.1-7.8).

*Remarks.*—This richly colored race has a much more restricted distribution than *leucurus*, occurring chiefly in the deserts of north-eastern Arizona. Specimens from Fredonia, in extreme northern Arizona, do not differ appreciably from those living on the south side of the Colorado River; at Kanab and Mount Carmel, Utah, however, the animals are paler and show evidence of intergradation with *leucurus*. The series from Bluff City and Noland Ranch, on the San Juan River, southeastern Utah, is typical. One specimen from Coventry, Colo., seems referable to *cinnamomeus*, although it appears to represent an intrusion into the range of *C. l. pennipes*.

*Specimens examined.*—Total number, 110, as follows:

**Arizona:** Apache County (near Keams Canyon), 3; Aztec Tank (Coconino County), 5; Cedar Ranch Wash (Locket Tank, Coconino County), 2; Deadman Wash (Coconino County), 1; Fredonia, 4; Grand Canyon, 9 (Indian Gardens, 6; Pipe Creek, 2; Bass Camp, 1); Holbrook (Navajo County), 9; Jacobs Pool (Coconino County), 4; Kayenta (Navajo Indian Reservation), 1; Keams Canyon (Navajo County), 11; Lees Ferry (north side), 3; Lukachukai (Navajo Indian Reservation), 2; O'Leary Peak (6,000 feet altitude), 1; Oraibi (Hopi Indian Reservation), 4; Painted Desert, 8; Taylor (Navajo County), 1; Tuba (Coconino County), 5; Winslow, 12; Zuni River (Apache County), 1.

**Colorado:** Ashbaugh's Ranch (near McElmo, Montezuma County), 1; Coventry, 1.

**Utah:** Bluff City (San Juan River), 6; Kanab, 6; Mount Carmel (Kane County), 3; Noland Ranch (San Juan River), 2; Notom (Wayne County), 2;<sup>80b</sup> Willow Tank Spring (Kane County), 3.<sup>80b</sup>

#### CITELLUS LEUCURUS PENNIPES (HOWELL)

##### COLORADO ANTELOPE SQUIRREL

*Ammospermophilus leucurus pennipes* Howell, Jour. Mammal. 12: 162, May 14, 1931.

*Type.*—Collected at Grand Junction, Colo., November 11, 1895, by A. H. Howell; female adult, skin and skull, no. 75683, U. S. Natl. Mus. (Biological Survey collection) (orig. no. 494).

*Range.*—The Colorado Valley and its tributaries (except the San Juan) in western Colorado, eastern Utah, and northwestern New Mexico; north to Vernal, Utah and Rangely, Colo.; west to Thurber, Utah; south to Socorro Mountains, N. Mex. (fig. 17). *Zonal range:* Upper Sonoran.

*External characters.*—Similar to *C. l. cinnamomeus*, but upper parts in winter pelage more grayish (less vinaceous) and in summer pelage darker and more brownish. Compared with *C. l. leucurus*: Upper parts in winter pelage averaging more vinaceous (less grayish) in general tone; in summer pelage decidedly more vinaceous.

*Cranial characters.*—Skull similar to that of *cinnamomeus* but averaging slightly larger; decidedly larger than that of *leucurus*.

*Color.*—*Winter pelage* (November): Upper parts light vinaceous cinnamon, the hairs on the median dorsal area from crown to rump extensively tipped with white; flanks and hind legs vinaceous cinna-

<sup>80b</sup> Brigham Young Univ.

mon, shading to pale pinkish buff on the hind feet; front feet similar; lateral stripes creamy white; tail above, mixed black and grayish white, shaded with the body color at the base, the hairs showing a broad subterminal band of black; tail beneath, creamy white, bordered with black; under parts white, tinged with pale buff. *Summer pelage* (June): Upper parts light pinkish cinnamon, more or less darkened on the median dorsal area by the fuscous bases of the hairs and shaded on the shoulders by a wash of white; flanks and hind legs light vinaceous cinnamon, shading to pinkish buff on the feet; under parts buffy white; tail as in the winter pelage.

*Molt*.—A specimen from Huntington, Utah, taken in April, shows the summer pelage coming in on the head and fore back.

*Measurements*.—Average of 10 adults (4 males, 6 females) from type locality: Total length, 226.6 (220–239); tail vertebrae, 68.8 (60–76); hind foot, 39 (38–41); ear from notch (dry), 8.7 (7–10). *Skull*: Average of 9 adults (5 males, 4 females) from type locality: Greatest length, 40.2 (38.9–41.8); palatilar length, 18.2 (17.8–18.6); zygomatic breadth, 23.2 (22.6–24.2); cranial breadth, 18.9 (18.4–19.5); interorbital breadth, 9.6 (9.3–10.1); postorbital constriction, 13.7 (13.1–14.5); length of nasals, 12.7 (12–13.7); maxillary tooth row, 7.1 (6.3–7.5).

*Remarks*.—This race, apparently most closely related to *cinnamomeus*, differs from it in being less strongly vinaceous in color; in this respect it approaches *leucurus* but it has a decidedly larger skull. A series in full winter pelage from Fruitland and Shiprock, N. Mex., agrees closely with typical *pennipes*, and differs markedly from the series of *cinnamomeus* from Bluff City, Utah, lower down in the same valley. Specimens from Jemez, Rio Puerco, and Socorro Mountains, N. Mex., seem referable to *pennipes* and show no approach to *C. in-terpres*, which occurs on the eastern side of the Rio Grande Valley.

*Specimens examined*.—Total number, 72, as follows:

**Colorado:** Fruita, 1; Grand Junction, 22; Hotchkiss, 2; Rangely (Rio Blanco County), 1; White River (20 miles east of Rangely), 2.

**New Mexico:** Albuquerque (35 miles west), 1; Fruitland (San Juan County), 12; Jemez (Sandoval County), 2; Rio Puerco (Valencia County), 1; Shiprock (San Juan County), 2; Socorro Mountains (10 miles northwest), 1.

**Utah:** Emery County (near Huntington), 1; Henry Mountains, 2; Junction of Green and White Rivers, 1;<sup>81</sup> Lyman (Wayne County), 1;<sup>82</sup> Ouray (8 and 15 miles southwest), 11;<sup>81</sup> Thurber (Wayne County), 4; Uncompahgre Indian Reservation, 1;<sup>83</sup> Vernal, 4.

#### CITELLUS LEUCURUS PENINSULAE (ALLEN)

##### WESTERN PENINSULAR ANTELOPE SQUIRREL

*Tamias leucurus peninsulae* Allen, Amer. Mus. Nat. Hist. Bull. 5: 197, Aug. 18, 1893.

*Citellus leucurus peninsulae* Elliot, Field Columb. Mus. Pub., Zool. Ser. 3: 211, 1903.

*Ammospermophilus leucurus peninsulae* Mearns, U. S. Natl. Mus. Bull. 56: 299, 1907.

*Type*.—Collected at San Telmo, Baja California, April 30, 1893, by A. W. Anthony; male adult, skin and skull, no.  $\frac{5314}{4948}$ , Amer. Mus. Nat. Hist. (orig. no. 8).

<sup>81</sup> Carnegie Mus.

<sup>82</sup> Utah State Agr. College.

<sup>83</sup> Field Mus. Nat. Hist.

*Range.*—Western side of the Baja California Peninsula; east to the base of the San Pedro Martir Mountains; south to San Fernando (fig. 17). *Zonal range:* Upper Sonoran.

*External characters.*—Similar to *C. l. leucurus*, but darker throughout; the upper parts a deeper shade of vinaceous and with more black intermixed; feet darker cinnamon; tail more blackish above and more buffy beneath, the hairs having two black bands.

*Cranial characters.*—Skull similar to that of *leucurus*, but averaging larger.

*Color.*—*Summer pelage* (August 22): Head and upper parts pinkish cinnamon, more or less heavily mixed with black, the general tone near army brown; eye ring and lateral stripes creamy white; front legs and feet pinkish cinnamon or mikado brown; hind legs mikado brown or vinaceous cinnamon, shading to light pinkish cinnamon on the feet; tail above, cinnamon at base, the rest black, slightly tipped with grayish white; tail beneath, cartridge buff or buffy white, bordered with black and tipped with grayish white; under parts cartridge buff or buffy white.

*Variation.*—One topotype (Aug. 21) has the nape and shoulders rather heavily sprinkled with grayish white. Some specimens have considerable black on the terminal portion of the tail, due to the presence of the band of black near the base of the hairs. *Winter (?) pelage:* Specimens taken August 21 to 23 have acquired a fresh pelage covering the posterior half of the body; the general tone is near army brown, shading to vinaceous cinnamon on the legs and to light vinaceous cinnamon or pinkish buff on the feet.

*Molt.*—An adult female taken August 21 at San Telmo shows a fresh pelage covering the posterior half of the back, similar in color to the summer pelage. An adult male from San Quintin, August 8, shows a fresh pelage appearing on the rump; an adult female from the same locality, August 23, is in similar condition, the new pelage covering nearly the posterior half of the body.

*Measurements.*—Average of 5 adults (2 males, 3 females), from type locality: Total length, 224 (219–230); tail vertebrae, 74 (72–77); hind foot, 39.1 (38.5–40); ear from notch (dry), 8 (7–9). *Skull:* Average of 5 adults from type locality: Greatest length, 39.9 (38.9–41.4); palatilar length, 18 (17–19); zygomatic breadth, 23.2 (22.2–23.8); cranial breadth, 19 (18.7–19.3); interorbital breadth, 9.8 (9.6–10); postorbital constriction, 14.8 (14–15.2); length of nasals, 12.2 (11.3–12.5); maxillary tooth row, 7.4 (7–7.7).

*Remarks.*—This subspecies has a rather limited range on the western side of the Baja California Peninsula. It is closely related to *C. l. extimus*, which occupies the southern end of the peninsula, but its range is separated from that of *extimus* by a desert area occupied by *C. l. canfieldae*.

*Specimens examined.*—Total number, 44, as follows:

**Baja California:** Agua Escondido (near Hanson Laguna), 2;<sup>87</sup> La Huerta (west base Hanson Laguna Mountains), 1; Rancho La Progres, 2;<sup>84</sup> Rancho Viejo (15 miles east of Alamo), 2; Rosario, 10;<sup>85 86</sup> San Fernando, 2; San Quintin, 15; San Rafael Valley (20 miles east of Ojos Negros), 1; San Telmo, 8; Trinidad Valley, 1.<sup>87</sup>

<sup>84</sup> Amer. Mus. Nat. Hist.

<sup>85</sup> Mus. Comp. Zool.

<sup>86</sup> Los Angeles Museum.

<sup>87</sup> Field Mus. Nat. Hist.

## CITELLUS LEUCURUS CANFIELDAE (HUEY)

## MID-PENINSULAR ANTELOPE SQUIRREL

*Ammospermophilus leucurus canfieldae* Huey, San Diego Soc. Nat. Hist. Trans. 5: 243, Feb. 27, 1929.

*Type*.—Collected at Punta Prieta, Baja California, Mexico (lat. 28°56' north; long. 114°12' west), February 14, 1928, by Laurence M. Huey; male adult, skin and skull, no. 6783, San Diego Soc. Nat. Hist.

*Range*.—Desert region of central Baja California, from about latitude 30° southward over the Vizcaino Desert to about latitude 28° (fig. 17). *Zonal range*: Lower Sonoran.

*External characters*.—Similar in color to *C. l. leucurus* but darker on body and limbs; under side of tail with more black, due to the presence of an additional black band on some of the hairs. Compared with *C. l. peninsulae* and *C. l. extimus*, the color is paler.

*Cranial characters*.—Skull closely similar to that of *leucurus*, but with relatively wider interpterygoid fossa; smaller than that of *peninsulae*.

*Color*.—*Winter pelage* (February): Nose and front of face cinnamon; sides of head grayish white, shaded with fuscous; hairs on upper parts, from crown to rump, fuscous subterminally, tipped with grayish white on fore back and with light pinkish cinnamon on middle and hinder back (the general tone near cinnamon drab); lateral stripes clear white; flanks and hind legs, shoulders, and fore legs, vinaceous cinnamon, shading to light pinkish cinnamon on the feet; tail above, like the back for about one-third of its length, then mixed black and grayish white; tail beneath, creamy white in the center, somewhat darkened by the presence of a narrow band of black on the middle portion of some of the hairs; all the hairs having a broad subterminal band of black, tipped with white; under parts creamy white. *Worn summer pelage* (September): Upper parts and feet nearly uniform pinkish cinnamon or light pinkish cinnamon. *Young* (Sept. 9): Similar to summer adults, but shoulders and fore back heavily sprinkled with white.

*Molt*.—A much worn young individual taken September 16 at Calamahue shows new pelage covering the head; an adult from Santa Domingo, September 27, had acquired the winter pelage over the posterior half of the body.

*Measurements*.—Average of 5 adults (2 males, 3 females): Total length, 220.6 (215–226); tail vertebrae, 70.8 (66–78); hind foot, 36 (35–38); ear from notch (dry), 8.2 (8–8.5). *Skull*: Average of 6 adults (3 males, 3 females): Greatest length, 38.5 (37.5–39); palatilar length, 17.2 (17–17.5); zygomatic breadth, 22.3 (21.9–22.7); cranial breadth, 18.3 (18–19); interorbital breadth, 9.3 (8.9–10); postorbital constriction, 13.6 (12.9–14.3); length of nasals, 11.7 (11–12.6); maxillary tooth row, 6.9 (6.5–7.1).

*Remarks*.—This race, occupying a desert area in the middle of the Baja California Peninsula, is intermediate between *leucurus* on the north and *extimus* on the south, with both of which it intergrades where their ranges meet.

*Specimens examined*.—Total number, 15, as follows:

Baja California: Calamahue, 4; Campo Los Angeles, 2;<sup>88</sup> Jaraguay (58 miles southeast of San Fernando), 2; Mesquitil, 1;<sup>88</sup> Punta Prieta, 2;<sup>88</sup> San Andres, 1;<sup>89</sup> Santo Domingo, 2; Yubay (30 miles southeast of Calamahue), 1.

<sup>88</sup> San Diego Soc. Nat. Hist.

<sup>89</sup> Mus. Comp. Zool.

## CITELLUS LEUCURUS EXTIMUS (NELSON AND GOLDMAN)

## SOUTHERN PENINSULAR ANTELOPE SQUIRREL

*Ammospermophilus leucurus extimus* Nelson and Goldman, Jour. Wash. Acad. Sci. 19: 281, July 19, 1929.

*Type*.—Collected at Saccaton (15 miles north of Cape San Lucas), Baja California, Mexico, December 29, 1905, by E. W. Nelson and E. A. Goldman; female adult, skin and skull, no. 146587, U. S. Natl. Mus. (Biological Survey collection) (orig. no. 18805).

*Range*.—Southern part of the Baja California Peninsula, from Cape San Lucas north to about latitude 28° (except the Vizcaino Desert); ranging from sea level to about 1,000 feet altitude on the slopes of the mountains (fig. 17). *Zonal range*: Lower Sonoran and Tropical.

*External characters*.—Similar to *C. l. canfieldae*, but larger, and darker (more brownish), especially on the head, rump, and thighs. Similar to *C. l. peninsulae* in color, but slightly paler, the rump and thighs more vinaceous in tone rather than ochraceous.

*Cranial characters*.—Skull larger than that of *canfieldae* and *C. l. leucurus*, with relatively smaller bullae; closely similar to that of *peninsulae*, the bullae averaging slightly broader (less wheel shaped).

*Color*.—*Winter pelage*: Top of head vinaceous cinnamon, shaded with fuscous; sides of head grayish white, shaded with fuscous; eye ring white; upper parts light vinaceous cinnamon, shaded with grayish white on shoulders and fore back and heavily mixed with fuscous on middle and hinder back; lateral stripes creamy white; hips and thighs vinaceous cinnamon; fore and hind feet light vinaceous cinnamon; tail above, mixed black and buffy white; tail beneath, grayish white or cartridge buff, bordered with black and tipped with buffy white; under parts buffy white. *Summer pelage* (September): Upper parts vinaceous cinnamon, darkest on the head and rump, becoming light vinaceous cinnamon on the shoulders and fore legs.

*Molt*.—No specimens are available to show the progress of the spring molt; the fall molt begins in October on the hinder part of the body; a specimen from El Potrero, October 31, has acquired new pelage over the whole body excepting the head; one from Comondú, November 7, is in the same condition, the head retaining old worn pelage.

*Measurements*.—Average of 10 adults from southern Baja California (Comondú to Cape San Lucas): Total length, 219.8 (208–237); tail vertebrae, 79 (70–87); hind foot, 37.2 (35–38); ear from notch, 8.9 (8–10). *Skull*: Average of 11 adults from Saccaton and Cape San Lucas: Greatest length, 40.3 (39–41.6); palatilar length, 19 (17.5–20); zygomatic breadth, 23 (22.5–23.8); cranial breadth, 18.6 (18.2–19); interorbital breadth, 9.9 (9.2–10.3); postorbital constriction, 13.5 (12.7–14.9); length of nasals, 12.9 (11.5–13.7); maxillary tooth row, 7 (6.3–7.6).

*Remarks*.—This race, occupying the southern end of the peninsula of Baja California, is most nearly related to *peninsulae* of the north-west coast region; their ranges are separated, however, by the range of *canfieldae*, a smaller and paler race occupying the desert region in the middle of the peninsula.

*Specimens examined.*—Total number, 70, as follows:

**Baja California:** Aguaje de San Estaban, 1; Cape San Lucas, 24; Comondú, 9; El Potrero, 2; La Paz, 4; Matancita, 1; Saccaton (15 miles north of Cape San Lucas), 4; San Bruno, 1; San Ignacio, 6; San Jose (30 miles north of La Purisima), 2; San Jose del Cabo, 5; San Juanico Bay, 2;<sup>90</sup> San Pablo, 6; Santana, 3.<sup>91</sup>

### CITELLUS INTERPRES (MERRIAM)

#### TEXAS ANTELOPE SQUIRREL

*Tamias interpres* Merriam, North Amer. Fauna 4: 21, Oct. 8, 1890.

*Spermophilus interpres* Bryant, Zool. 3: 208, October 1892.

[*Citellus*] *interpres* Elliot, Field Columb. Mus. Pub., Zool. Ser. 4: 143, 1904.

*Ammospermophilus interpres* Bailey, North Amer. Fauna 25: 81, 1905.

*Ammospermophilus leucurus interpres* Mearns, U. S. Natl. Mus. Bull. 56: 301, 1907.

*Type.*—Collected at El Paso, Tex., December 10, 1889, by Vernon Bailey; female adult, skin and skull, no.  $\frac{18160}{25060}$ , U. S. Natl. Mus. (Biological Survey collection) (orig. no. 762).

*Range.*—Western Texas and south-central New Mexico, north to the Manzano Mountains; east to the Pecos River Valley and the Castle Mountains, Tex.; west to the eastern side of the Rio Grande Valley in New Mexico; south to Jaral, Coahuila (fig. 17). *Zonal range:* Lower Sonoran.

*External characters.*—Closely similar in winter pelage to *C. leucurus leucurus*, but differing from it in having an additional black band on the tail hairs; coloration much paler and more grayish (less reddish) than in *C. l. cinnamomeus*.

*Cranial characters.*—Skull similar to that of *cinnamomeus* but with superior outline flatter and brain case shallower; nasals broader at posterior end, truncated squarely on a line with the ends of the premaxillae; upper tooth row shorter.

*Color.*—*Winter pelage:* Upper parts light drab or drab gray (the tips of the hairs white, with a subterminal band of fuscous); nose and front of face washed with pinkish cinnamon; eye ring white; front and hind legs, and hips, pinkish cinnamon or light pinkish cinnamon; feet light pinkish cinnamon, shaded with buffy white; tail above, mixed black and white, with a patch of light pinkish cinnamon at the proximal end; tail beneath, creamy white, bordered with black and with a free black band on the middle portion of some of the hairs; under parts white.

*Variation.*—Two specimens from the Manzano Mountains, N. Mex., are slightly darker (pale fawn color) on the rump and hind legs.

*Molt.*—A specimen taken at Boquillas, Tex., May 23, is in a badly worn pelage, and shows new hair coming in on the head and fore back.

*Measurements.*—Average of 10 adults (8 males, 2 females) from El Paso, Tex.: Total length, 226 (220-235); tail vertebrae, 74.2 (68-84); hind foot, 37.8 (36-40); ear from notch (dry), 9.8 (8-11). *Skull:* Average of 14 adults (8 males, 6 females) from El Paso: Greatest length, 39.3 (37.7-40.5); palatilar length, 17.3 (16-18.2); zygomatic breadth, 22.7 (21.5-23.8); cranial breadth, 18.9 (18-19.6); interorbital breadth, 9.9 (9.4-10.5); postorbital constriction, 14.5 (13.8-15.3); length of nasals, 12.6 (11.8-13.8); maxillary tooth row, 6.6 (6.4-6.9).

<sup>90</sup> Amer. Mus. Nat. Hist.

<sup>91</sup> Mus. Comp. Zool.

*Remarks.*—The range of this species seems to be restricted to the region east and north of the Rio Grande. There is no evidence of intergradation with *cinnamomeus*; the latter is known from specimens taken in the Socorro Mountains, a few miles west of the Rio Grande, whereas *interpres* is known from the eastern side of the river, at a point nearly opposite.

*Specimens examined.*—Total number, 62, as follows:

Coahuila: Jaral, 1.<sup>82</sup>

New Mexico: Manzano Mountains (east foothills), 2; Organ Mountains, 1;<sup>83</sup>

San Andres Mountains, 11; Socorro (10 miles northeast), 1.

Texas: Boquillas, 3; Castle Mountains (Crockett County), 1; El Paso, 32; Fort Lancaster (near Sheffield, Crockett County), 1; Franklin Mountains (10 miles north of El Paso), 6; Guadalupe Mountains (south end), 1; High Bridge, Pecos River (mouth), 1; Sierra Blanca, 1.

#### CITELLUS INSULARIS (NELSON AND GOLDMAN)

##### ESPIRITU SANTO ANTELOPE SQUIRREL

*Ammospermophilus leucurus insularis* Nelson and Goldman, Biol. Soc. Wash. Proc. 22: 24, Mar. 10, 1909.

*Citellus leucurus insularis* Elliot, Sup. Check-list Mammals North Amer., p. 28, 1917.

*Type.*—Collected on Espiritu Santo Island, Gulf of California, Baja California, Mexico, February 7, 1906, by E. W. Nelson and E. A. Goldman; female adult, skin and skull, no. 146783, U. S. Natl. Mus. (Biological Survey collection) (orig. no. 19072).

*Range.*—Espiritu Santo Island, Baja California (fig. 17). *Zonal range:* Tropical.

*External characters.*—Closely similar to *C. leucurus extimus* in color, but larger, and slightly darker on flanks and hind legs; tail about same length.

*Cranial characters.*—Skull similar to that of *extimus* but larger in all dimensions except the maxillary tooth row, in which the anterior premolar ( $pm^3$ ) is lacking entirely in about half the specimens and very rudimentary in the rest.

*Color.*—In worn winter pelage practically as in *extimus*, except on the flanks and hind legs, which are light pinkish cinnamon. The fresh pelage is not represented in the series examined.

*Measurements.*—Average of 7 adults from type locality: Total length, 229 (210–240); tail vertebrae, 78 (71–83); hind foot, 38.3 (36–40); ear from notch, 9.1 (8–11). *Skull:* Average of 5 adults from type locality: Greatest length, 41.8 (40.3–42.4); palatilar length, 18.4 (18–19); zygomatic breadth, 24.2 (23.9–24.7); cranial breadth, 18.9 (18.7–19); interorbital breadth, 10.1 (9.8–10.6); postorbital constriction, 13.8 (13.4–14); length of nasals, 13.6 (12.3–14.3); maxillary tooth row, 6.5 (6.4–6.7).

*Remarks.*—Although resembling the mainland race (*extimus*) very closely in color this island species has developed pronounced cranial and size characters.

*Specimens examined.*—Total number, 14, from type locality.

<sup>82</sup> Field Mus. Nat. Hist.

<sup>83</sup> State College, N. Mex.

## CITELLUS NELSONI (MERRIAM)

## SAN JOAQUIN ANTELOPE SQUIRREL

*Spermophilus nelsoni* Merriam, Biol. Soc. Wash. Proc. 8: 129, Dec. 28, 1893.

*Citellus nelsoni* Elliot, Field Columb. Mus. Pub., Zool. Ser. 3: 290, 1904.

*Ammospermophilus nelsoni* Lyon and Osgood, U. S. Natl. Mus. Bull. 62: 172, 1909.

*Ammospermophilus nelsoni amplus* Taylor, Calif. Univ. Pubs., Zool. 17: 15, 1916  
(20 miles south of Los Banos, Merced County, Calif.).

*Type*.—Collected at Tipton, Tulare County, Calif., June 24, 1893, by C. P. Streater; male adult, skin and skull, no. 54651, U. S. Natl. Mus. (Biological Survey collection) (orig. no. 2968).

*Range*.—San Joaquin Valley, Calif., from Los Banos south to Fort Tejon; west to the Carriso Plain and Cuyama Valley (fig. 17).

*Zonal range*: Lower Sonoran.

*External characters*.—Similar to *C. leucurus leucurus* but colors more buffy (less grayish) in both winter and summer pelage.

*Cranial characters*.—Skull similar to those of *leucurus* and *C. l. cinnamomeus*, but larger, with heavier and more wide spreading zygomatic and larger audital bullae.

*Color*.—*Summer pelage*; Upper parts uniform pinkish buff or pale pinkish buff; a narrow stripe of creamy white on either side of the dorsal area, from the shoulders to the rump; fore and hind limbs light pinkish cinnamon, the feet pinkish buff; tail like the back for the basal third above, the remainder black or fuscous black, edged with creamy white; tail beneath, creamy white, with a subterminal band of blackish; under parts creamy white. *Winter pelage* (October): General tone of upper parts varying from wood brown to light drab, the hairs with a subterminal band of fuscous and tipped with pinkish buff or buffy white; front legs light pinkish cinnamon next the body, shading to pinkish buff on the feet; hind legs and thighs pinkish cinnamon or sayal brown.

*Molt*.—The spring molt occurs in late April or early May. Specimens taken April 15 are still in worn winter pelage; a female from Carriso Plain, April 27, has nearly completed the molt, there being a patch of winter pelage still remaining on the head and another patch on the hinder back; another female taken at Bakersfield, May 6, shows new pelage coming in irregularly on the head, sides, and middle of the back. The fall molt occurs in September and progresses from the rump forward; a specimen taken at Mendota, September 28, had acquired fresh winter pelage over the posterior half of the back and sides; another taken at Alila, October 8, has the fresh pelage covering all but the head and face.

*Measurements*.—Average of 10 adult males from type locality: Total length, 231.2 (218–240); tail vertebrae, 70 (63–79); hind foot, 41.2 (40–43); ear from notch (dry), 8.2 (8–9). Average of 10 adult females from type locality: Total length, 229.9 (221–237); tail vertebrae, 67.4 (62–72); hind foot, 39.7 (39–41); ear from notch, 8.5 (8–9.5). *Skull*: Average of 12 adults (3 males, 9 females) from type locality: Greatest length, 41.1 (40–41.9); palatilar length, 18.9 (18–19); zygomatic breadth, 24.5 (23.5–25.7); cranial breadth, 19.6 (18.8–20.6); interorbital breadth, 10.1 (9.6–10.5); postorbital constriction, 13.8 (13.5–14.3); length of nasals, 12.4 (11.2–13); maxillary tooth row, 7.7 (7.2–8.5).

*Remarks*.—This species is quite distinct from *leucurus*, and the ranges of the two do not overlap, so far as known. Its habits are similar to those of the other members of the subgenus *Ammospermophilus*.

Comparison of a typical series of "*amplus*" with typical *nelsoni* shows the differences to be too slight to warrant recognition in nomenclature. The skulls average slightly larger—about one millimeter in length and in zygomatic breadth. No appreciable difference in color can be detected.

*Specimens examined*.—Total number, 210, as follows:

California: Adobe Station (near Kern Lake), 1; Alcalde (Fresno County), 7; Alila (= Earlimart), 8; Bakersfield (8 miles northeast and 20 miles south), 37;<sup>94</sup> Buena Vista Lake, 3; Carriso Plain, 11; Coalinga, 3; Cuyama Valley, 10; Dos Palos, 2; Firebaugh (Fresno County), 1;<sup>94</sup> Five Willow Springs (23 miles southeast of Simmler), 4; Huron (Fresno County), 8; Los Banos, 30;<sup>94</sup> Lerdo (Kern County), 2; Maricopa, 4;<sup>94</sup> McKittrick, 5; Mendota (Fresno County), 7; Panoche Creek (10–15 miles southwest of Mendota), 2;<sup>95</sup> Panoche Pass (Fresno County), 1;<sup>95</sup> Poso (= Famoso, Kern County), 3; Rose Station (4 miles north of Fort Tejon), 5;<sup>96</sup> Santa Maria Springs (7 miles southwest of McKittrick), 1; Simmler (8 miles east, on Carriso Plain), 11; Stanley (= Turk, Fresno County), 1; Sunset (= Hazelton, Kern County), 5; Templea Mountains, 2; Tipton (Tulare County), 36.

### Subgenus XEROSPERMOPHILUS Merriam

[Characters on p. 45]

#### KEY TO SPECIES AND SUBSPECIES

- a*<sup>1</sup>. Under side of tail white----- *mohavensis* (p. 183)  
*a*<sup>2</sup>. Under side of tail not white.  
*b*<sup>1</sup>. Upper parts drab.  
*c*<sup>1</sup>. Darker----- *tercticandus* (p. 185)  
*c*<sup>2</sup>. Paler (light drab)----- *chlorus* (p. 188)  
*b*<sup>2</sup>. Upper parts vinaceous cinnamon or cinnamon drab.  
*c*<sup>1</sup>. Paler (light vinaceous cinnamon)----- *tercticandus* (p. 185)  
*c*<sup>2</sup>. Darker (vinaceous cinnamon or cinnamon drab).  
*d*<sup>1</sup>. Habitat Arizona and Sonora----- *neglectus* (p. 187)  
*d*<sup>2</sup>. Habitat Baja California----- *apricus* (p. 190)

### CITELLUS MOHAVENSIS (MERRIAM)

#### MOHAVE GROUND SQUIRREL

*Spermophilus mohavensis* Merriam, North Amer. Fauna 2: 15, Oct. 30, 1889.

[*Citellus*] *mohavensis* Trouessart, Cat. Mamm., Sup., p. 341, 1904.

[*Citellus*] *tercticandus mohavensis* Elliot, Field Columb. Mus. Pub., Zool. Ser. 3: 291, 1904.

*Type*.—Collected near Rabbit Springs, about 15 miles east of Hesperia, San Bernardino County, Calif., June 29, 1886, by Frank Stephens (Grinnell and Dixon, 1918, p. 667); male adult, skin and skull, no. 186469, U. S. Natl. Mus. (no.  $\frac{2594}{3223}$ , Merriam collection) (orig. no. 315).

*Range*.—Mohave Desert, Calif., west to Palmdale, Los Angeles County; north to Haiwee Meadows, Inyo County; south to Rabbit Springs, San Bernardino County (fig. 18). *Zonal range*: Lower Sonoran.

*External characters*.—Similar in external appearance to *C. townsendii mollis* but general tone of upper parts more pinkish (less grayish) without trace of mottling; under side of tail clear whitish instead of cinnamon.

<sup>94</sup> Mus. Vert. Zool.

<sup>95</sup> W. T. Shaw collection.

<sup>96</sup> Field Mus. Nat. Hist.

*Cranial characters.*—Skull similar to that of *C. tereticaudus* but averaging larger; slightly larger than that of *C. townsendii mollis* and differing from it in the characters distinguishing the subgenus *Xerospermophilus*; brain case short and broad; rostrum short, the nasals ending nearly on a line with the premaxillae; zygomata heavy, widely expanded, and twisted so that they occupy a position about

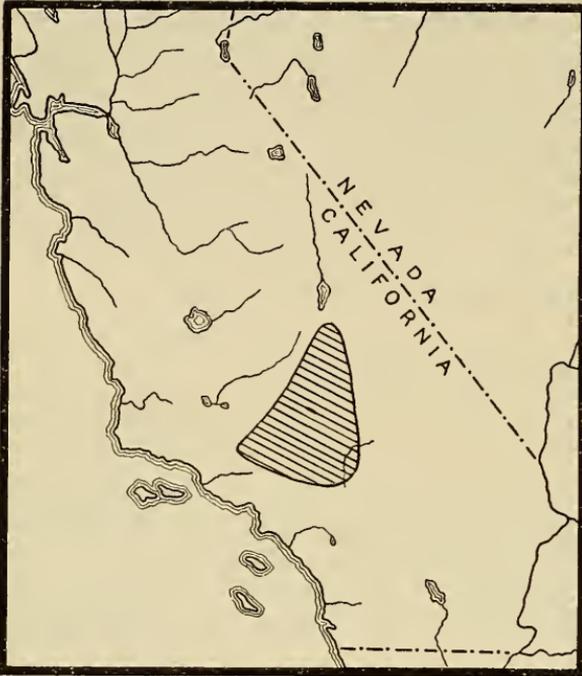


FIGURE 18.—Distribution of *Citellus mohavensis*.

midway between vertical and horizontal; postorbital processes broad at base, narrowing rapidly to slender tip, which is depressed; incisors moderately short and stout, slightly recurved; auditory bullae broad and evenly rounded, considerably inflated.

*Color.*—*Unworn winter pelage* (March): Upper parts uniform light drab, with a tinge of light vinaceous cinnamon, strongest on the forehead; front feet light pinkish cinnamon; hind feet pale buff, washed with light pinkish cinnamon or pinkish buff; tail above fus-

couc, overlaid with creamy white; tail beneath, clear creamy white; under parts creamy white. *Summer pelage* (May): Upper parts drab or avellaneous.

*Molt.*—A female specimen taken May 12 shows a new pelage covering the head, shoulders, and most of the back.

*Measurements.*—Average of 11 adults from Mohave Desert, Salt Wells Valley, and Palmdale: Total length, 222.5 (210–230); tail vertebrae, 65.5 (57–72); hind foot, 35.5 (32–38). *Skull:* Average of 11 adults from Mohave Desert, Salt Wells Valley, and Little Lake: Greatest length, 38.7 (38.1–40); zygomatic breadth, 24.3 (23.5–25.3); breadth of cranium, 18.2 (17.6–19.3); interorbital breadth, 8.7 (7.4–9.6); postorbital constriction, 12.7 (11.8–13.3); length of nasals, 12.9 (12.2–13.5); maxillary tooth row, 7.8 (7.6–8).

*Remarks.*—The Mohave ground squirrel is remarkable for the limited extent of its range and for the fact that it has no near relatives. It is readily distinguished from the other unspotted ground squirrels by the white under surface of the tail. Its range apparently meets but does not overlap that of *tereticaudus*. The latter occupies the eastern side of the Mohave Desert as far west as Daggett (Elliot's record of *C. mohavensis* at Daggett (1904, p. 291) is an error, all the specimens taken there being *C. tereticaudus*), while *mohavensis* occurs on the western side, along the Mohave River.

*Specimens examined*.—Total number, 23, as follows:

**California:** Haiwee Meadow (10 miles south of Owens Lake), 1; Hesperia (San Bernardino County), 1;<sup>87</sup> Little Lake (Inyo County), 2;<sup>88</sup> Mohave, 1; Mohave Desert, 2; "Mohave River" (=Rabbit Springs, 15 miles east of Hesperia), 6; Oro Grande (San Bernardino County), 1; Palmdale, 1; Salt Wells Valley (=north end Mohave Desert), 7; Victorville, 1.<sup>89</sup>

CITELLUS TERETICAUDUS (BAIRD)

[Synonymy under subspecies]

*Specific characters*.—Similar in general external appearance to *C. townsendii mollis*, but never with any traces of dappling; tail longer and less bushy; ears a mere rim; hind foot, 32–40 mm; tail, 60–102; skull length, 34.3–39.3. Skull closely similar to that of *C. mohavensis*. Upper parts vinaceous cinnamon, pinkish cinnamon, light drab, cinnamon drab, or ecru drab; tail beneath, drab or buff (never white).

CITELLUS TERETICAUDUS TERETICAUDUS (BAIRD)

ROUND-TAILED GROUND SQUIRREL

(Pls. 27, C; 32, C)

*Spermophilus tereticaudus* Baird, Pacific R. R. Rept. 8: 315, 1857.

*Citellus tereticaudus* Elliot, Field Columb. Mus. Pub., Zool. Ser. 3: 211, 1903.

*Citellus eremonomus* Elliot, Field Columb. Mus. Pub., Zool. Ser. 3: 243, 1903. (Furnace Creek, Death Valley, Calif.)

*Citellus tereticaudus mohavensis* Elliot, Ibid, p. 291, 1904 (not *Spermophilus mohavensis* Merriam).

*Citellus tereticaudus vociferans* Huey, Biol. Soc. Wash. Proc. 39: 29, 1926 (San Felipe, Baja California).

*Cotypes*.—Collected at Old Fort Yuma, Imperial County, Calif., by Maj. G. H. Thomas; male subadult, skin and skull, no.  $\frac{1584}{2419}$ ; female immature, in alcohol, no. 2490, U. S. Natl. Mus.

*Range*.—Deserts of southern California and northeastern Baja California; north to Death Valley, Calif., and Ash Meadows, Nev.; east to Bunkerville, Nev., and extreme northwestern Arizona; south to San Felipe Bay, Baja California; west to Kramer on the Mohave Desert (Grinnell and Dixon, 1918, p. 669) and to La Puerta, San Diego County, on the Colorado Desert (fig. 19). *Zonal range*: Lower Sonoran.

*External characters*.—Similar to *C. townsendii mollis* but tail much longer; coloration more pinkish (less grayish); under parts white instead of buff. Compared with *C. mohavensis*: Tail longer, less bushy, and nearly unicolor (not white beneath).

*Cranial characters*.—Skull similar to that of *mohavensis*, but averaging slightly smaller.

*Color*.—*Cinnamon phase* (unworn winter pelage): Upper parts light vinaceous cinnamon, the hairs with narrow whitish bands; sides of nose and face washed with dull white or pale smoke gray; eye ring whitish; feet white or cartridge buff; basal half of tail above, like back; terminal half shaded with fuscous and edged with whitish; tail beneath, cartridge buff; under parts white. *Drab phase*: Upper parts drab, some individuals shaded with cinnamon. In summer the pelage is thinner and slightly paler.

<sup>87</sup> Los Angeles Museum.

<sup>88</sup> Mus. Vert. Zool.

<sup>89</sup> E. T. Seton collection.

*Molt*.—The spring molt occurs from the middle of March to the middle of May, varying with the locality. There is no clear evidence of a fall molt, but judging from the full, silky pelage of winter specimens, it seems probable that there is a renewal of the pelage in fall.

*Measurements*.—Average of 11 adults from Fort Yuma and Pilot Knob, Calif.: Total length, 249.5 (235–266); tail vertebrae, 91.1 (81–102); hind foot, 36.2 (33–38). *Skull*: Average of 16 adults from same region: Greatest length, 36.5 (34.9–38.3); palatilar length, 16.9 (16–18.3); zygomatic breadth, 23 (21.8–24); breadth of cranium, 17.5 (16.8–18.5); interorbital breadth, 8.9 (8.2–10.3); postorbital constriction, 12.4 (11.7–13.1); length of nasals, 11.7 (10.3–12.8); maxillary tooth row, 7.2 (6.7–7.8).

*Remarks*.—The round-tailed ground squirrel has a wide range on the deserts of California and Baja California, and a closely related form (*C. t. neglectus*) occupies a large part of western Arizona and northern Sonora.

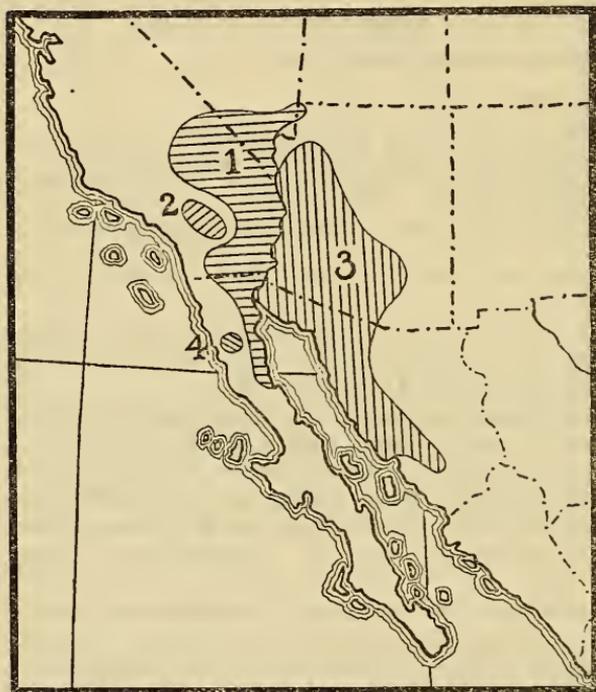


FIGURE 19.—Distribution of the subspecies of *Citellus tereticaudus*: 1, *C. t. tereticaudus*; 2, *C. t. chlorus*; 3, *C. t. neglectus*; 4, *C. t. apicus*.

Although closely related to *C. mohavensis* it is quite distinct from that species and apparently their ranges do not overlap.<sup>1</sup> Its resemblance in color to *mollis* does not of course indicate close relationship.

"*Citellus eremonus*" of Elliot was based on a small series from Death Valley taken in late April. There is now available from this valley a series of over 30 specimens, representing all the pelage variations, and showing that there are two color phases with numerous intermediate specimens. The cinnamon phase is represented in both summer and winter pelage and shows no appreciable differences from typical *tereticaudus* from the Colorado Valley. The drab phase is likewise represented in both pelages. A considerable series from Daggett, Calif., contains specimens representative of both color phases and some intermediates.

Comparison of a series of 30 topotypes of "*Citellus vociferans*" Huey with large series of typical *tereticaudus* shows that the alleged

<sup>1</sup> Elliot's assignment (1904, p. 291) of *mohavensis* as a subspecies of *tereticaudus* is based on a misidentification of specimens from Daggett, Calif., these being typical *tereticaudus*.

characters of "*vociferans*" are covered by individual and seasonal variation in *tereticaudus*.

*Specimens examined*.—Total number, 231, as follows:

- Baja California:** Gardner's Laguna, Salton River, 1; Mexicali, 4;<sup>4</sup> San Felipe, 24;<sup>2</sup> San Felipe Bay, 12.
- California:** Amargosa Valley, 1; Bard (Imperial County), 17;<sup>23</sup> Bargas Springs (=Borego, San Diego County), 1; Barstow, 2;<sup>45</sup> Blythe Junction (Riverside County), 4;<sup>4</sup> Brawley, 1; Calexico, 1; Colorado Desert (Carrizo Creek and Salt Creek), 5; Colorado River (opposite Parker, Ariz.), 1; Coyote Well (Imperial County), 4;<sup>4</sup> Daggett, 34;<sup>46</sup> Death Valley, 51;<sup>345</sup> Fort Yuma, 6; Indian Well, New River (San Diego County), 1; Ivanpah (San Bernardino County), 1; Laguna Dam (Imperial County), 4; La Puerta (San Diego County), 4;<sup>345</sup> Needles, 29; Pilot Knob (Imperial County), 6;<sup>4</sup> Riverside County (25 miles southwest of Ehrenburg, Ariz.), 1; Salton Lake, 6.<sup>4</sup>
- Nevada:** Ash Meadows (Nye County), 4; Bunkerville (Clark County), 1; Las Vegas, 1;<sup>3</sup> Muddy River (Clark County), 2;<sup>3</sup> Pahrump Valley, 1; St. Thomas, 1.<sup>7</sup>

### CITELLUS TERETICAUDUS NEGLECTUS (MERRIAM)

#### ARIZONA ROUND-TAILED GROUND SQUIRREL

*Spermophilus neglectus* Merriam, North Amer. Fauna 2: 17, Oct. 30, 1889.

*Spermophilus sonoriensis* Ward, Amer. Nat. 25: 158, 1891 (Hermosillo, Sonora, Mexico).

*Anisonyx (Ictidomys) tereticaudus* Allen, Amer. Mus. Nat. Hist. Bull. 7: 238, 1895.

[*Citellus*] *neglectus* Trouessart, Cat. Mamm., Sup., p. 341, 1904.

*Citellus tereticandus arizonae* Grinnell, Biol. Soc. Wash. Proc. 31: 105, 1918 (Tempe, Ariz.).

*Type*.—Collected at Dolan Spring, 12 miles northwest of Chloride, Mohave County, Ariz., February 9, 1889, by Vernon Bailey; male adult, skin and skull, no. 186470, U. S. Natl. Mus. (no.  $\frac{5652}{9952}$ , Merriam collection) (orig. no. 566).

*Range*.—Western Arizona and western Sonora; north to Detrital Valley, Mohave County, Ariz.; east to Mountain Spring, Pima County; south to Camoa, Sonora; west to the Colorado River and Gulf of California (fig. 19). *Zonal range*: Lower Sonoran.

*External characters*.—Similar to *C. t. tereticaudus* but darker, with shorter tail and hind foot.

*Cranial characters*.—Skull similar to that of *tereticaudus* but averaging slightly larger, with narrower rostrum and interorbital region; nasals longer.

*Color*.—*Winter pelage* (February): Upper parts cinnamon drab or vinaceous cinnamon, the hairs with short whitish tips; tail above, same color as back, tipped with fuscous and edged with buffy white; otherwise as in *tereticaudus*. *Summer pelage*: Similar to the winter pelage, but shorter, harsher, and averaging more pinkish.

*Molt*.—A specimen (♀ adult) from Fort Mohave, Ariz., March 11, is in a much worn pelage, with new hair covering the head; an adult male from Gadsden, Ariz., April 10, shows about the same condition; an adult female from Texas Hill, Ariz., April 24, has acquired a new pelage over most of the body, excepting the rump; several

<sup>2</sup> San Diego Soc. Nat. Hist.

<sup>3</sup> D. R. Dieck collection.

<sup>4</sup> Mus. Vert. Zool.

<sup>5</sup> Univ. Michigan Mus. Zool.

<sup>6</sup> Field Mus. Nat. Hist.

<sup>7</sup> California Inst. Tech.

specimens from Ortiz, Sonora, taken May 12, are in badly worn pelage, with new hair appearing on the head.

*Measurements.*—Average of 10 adults (7 males, 3 females) from Dolan Spring, Mellen, and Fort Mohave, Ariz.: Total length, 227 (204–247); tail vertebrae, 72 (60–84); hind foot, 34.4 (32–37). Average of 5 adult males from Parker, Ariz.: Total length, 233 (225–243); tail vertebrae, 85.8 (77–95); hind foot, 35.5 (34.5–37). *Skull:* Average of 10 adults (6 males, 4 females) from Dolan Spring, Fort Mohave, and Mellen, Ariz.: Greatest length, 37.1 (35.3–39.3); zygomatic breadth, 23.2 (22.2–23.8); breadth of cranium, 17.9 (17.3–18.3); interorbital breadth, 8.3 (7.8–9); postorbital constriction, 12.3 (12–12.7); length of nasals, 12.6 (11.8–13.7); maxillary tooth row, 7.6 (7.3–8).

*Weight.*—Two specimens, taken by Vernon Bailey, near Tucson, weighed, respectively, 116 and 133 g.

*Remarks.*—This ground squirrel, originally described as a distinct species, now proves to be a closely related race of *tereticaudus*. It has been redescribed twice, under the names *Spermophilus sonoriensis* and *Citellus tereticaudus* "*arizonae*", both Ward and Grinnell apparently having overlooked Merriam's description of *neglectus* in their comparisons. Large series of specimens from the type locality of "*sonoriensis*" and from various points in central Arizona show no important differences from typical *neglectus* from northwestern Arizona. The Sonoran series apparently has slightly shorter nasals (average, 11.6 mm) but in the absence of any color characters, it seems best not to recognize this form by name.

*Specimens examined.*—Total number, 292, as follows:

- Arizona:** Adonde (Yuma County), 4; Ajo 1; Cibola (Yuma County), 2;<sup>8</sup> Colorado River, at Monument no. 204, 10; Colorado River, 5 miles north-east of Laguna, 3;<sup>8</sup> Congress Junction, 4; Continental (Pima County), 1; Coyote Mountains (Pima County), 1; Dolan Spring (Mohave County), 3; Dome (Yuma County), 2; Fort Lowell (near Tucson), 16;<sup>9, 10</sup> Fort Mohave, 8; Gadsden, 4; Gunsight (Pima County), 1; Hackberry (Mohave County), 1; Little Meadows (east side Black Mountains, Mohave County), 1; Maricopa (Pinal County), 1; Mellen (=Topock, Mohave County), 5;<sup>1</sup> Mineral Park (Mohave County), 1; New River (30 miles northwest of Phoenix), 1; Parker, 7; Phoenix, 10; Picachio Reservoir (17 miles southwest of Florence), 1; Quartzsite (Yuma County), 2; Quitobaquito (Pima County), 4; Rillito (10 miles north, Pima County), 2;<sup>11</sup> Rillito Creek (5 miles north of Tucson), 1; Sabinos Canyon (Pima County), 3;<sup>11</sup> Santa Rita Range Reserve, 6; Santa Rita Mountains (west base), 1;<sup>8</sup> Tempe, 3;<sup>8</sup> Texas Hill (Yuma County), 3; Tinajas Desert (Yuma County), 1; Tucson, 19; Vicksburg (Yuma County), 2; Wellton (Yuma County), 5; Wickenburg, 2; Yuma, 60.
- Sonora:** Altar (20 miles north), 1;<sup>11</sup> Batamotal, 6; Camoa (Rio Mayo), 2; Cienega Well (30 miles south of Monument no. 204), 1; Costa Rica Ranch, 1; El Doctor, 7;<sup>10</sup> Guaymas, 2;<sup>11</sup> Hermosillo, 15; Libertad (50 miles north-east), 2;<sup>11</sup> Obregon, 1;<sup>10</sup> Ortiz, 48; Pitiquito, 1;<sup>11</sup> Querobabi, 1;<sup>12</sup> Rancho Carrizo, 2.<sup>10</sup>

#### CITELLUS TERETICAUDUS CHLORUS ELLIOT

##### PALM SPRINGS GROUND SQUIRREL

*Citellus chlorus* Elliot, Field Columb. Mus. Pub., Zool. Ser. 3: 242, 1903.

*Citellus tereticaudus chlorus* Grinnell, Calif. Acad. Sci. Proc. (4) 3: 347, 1913.

*Type.*—Collected at Palm Springs, Riverside County, Calif., February 16, 1903, by Edmund Heller; male adult, skin and skull, no. 12861, Field Museum of Natural History.

<sup>8</sup> Mus. Vert. Zool.

<sup>9</sup> Field Mus. Nat. Hist.

<sup>10</sup> D. R. Dickey collection.

<sup>11</sup> Univ. Michigan Mus. Zool.

<sup>12</sup> California Inst. Tech.

*Range*.—Northwestern arm of the Colorado Desert, specifically, the Coachella Valley from Mecca northwest to Cabazon (Grinnell and Dixon, 1918, p. 674) (fig. 19). *Zonal range*: Lower Sonoran.

*External characters*.—Similar to *C. t. tereticaudus* but coloration more drabby (less pinkish).

*Cranial characters*.—Practically the same as in *tereticaudus*.

*Color*.—*Winter pelage* (September 27–April): Upper parts uniform light drab, sometimes with a slight tinge of pinkish cinnamon; under parts white or creamy white; sides of nose grayish white; front feet buffy white; hind feet white; tail above, like back on proximal half, the distal half shaded with fuscous and edged with grayish white; tail beneath, light drab. *Summer pelage*: Upper parts nearest to ecru drab of Ridgway; this pelage is short and much harsher than the winter pelage, which is soft and silky.

*Molt*.—The summer pelage is acquired usually in March or April; a specimen from Agua Caliente, taken April 11, 1894 is in badly worn condition, and shows the new pelage covering the head and throat, an irregular patch on the rump, and smaller patches on the belly; one from Whitewater, April 21, 1894, shows new pelage covering the entire under parts and the anterior two-thirds of the upper parts. A breeding female from the same locality, June 3, 1908, is in a moderately worn drab pelage, apparently the left-over winter pelage. Other specimens taken April 3 and 10 are in complete summer pelage. The tail is renewed last; specimens taken at Mecca, April 24, show the new hair on the basal portion of the tail, while others taken at the same dates have the entire tail renewed. Winter pelage is apparently acquired in September; a specimen from Palm Springs September 27, is in complete fresh winter pelage.

*Measurements*.—Average of 10 adults (7 males, 3 females) from Palm Springs and Whitewater: Total length, 243.3 (232–255); tail vertebrae, 93.2 (84–100); hind foot, 36.4 (35–40). *Skull*: Average of 11 adults (8 males, 3 females) from type locality: Greatest length, 36 (35.1–37); zygomatic breadth, 22.2 (21.4–23.9); breadth of cranium, 17.6 (17.2–18.2); interorbital breadth, 8.6 (8.1–9.5); postorbital constriction, 12.7 (12.2–13.3); length of nasals, 11.2 (10.7–11.7); maxillary tooth row, 7.3 (7.2–7.6).

*Remarks*.—The color characters separating this race from typical *tereticaudus* are slight, but fairly constant. Writing of this form, Grinnell and Dixon (1918, p. 674) say:

The slight features by which this subspecies is distinguishable from the Yuma Round-tailed Ground Squirrel of the Imperial Valley southeast of Salton Sea may be inferred to have arisen as a result of the action of the body of water which formerly filled the Salton Sink to sea level in cutting off or isolating the animals in the northwestern arm of the Colorado Desert and thus giving them a chance to develop peculiarities of their own.

*Specimens examined*.—Total number, 91, as follows:

**California**: Agua Caliente (Riverside County), 10; Andreas Canyon, San Jacinto Mountains, 1; Cabazon (Riverside County), 1; Coachella (Riverside County), 1;<sup>13</sup> Mecca (Riverside County), 18;<sup>14 15</sup> Palm Springs, 38;<sup>13 14 15</sup>  
<sup>16 17 18</sup> Whitewater Station (Riverside County), 22.<sup>14 16</sup>

<sup>13</sup> D. R. Dickey collection.

<sup>14</sup> Mus. Vert. Zool.

<sup>15</sup> Univ. Michigan Mus. Zool.

<sup>16</sup> Acad. Nat. Sci. Philadelphia.

<sup>17</sup> Field Mus. Nat. Hist.

<sup>18</sup> Los Angeles Mus.

## CITELLUS TERETICAUDUS APRICUS HUEY

## TRINIDAD VALLEY GROUND SQUIRREL

*Citellus tereticaudus apricus* Huey, San Diego Soc. Nat. Hist. Trans. 5: 85, Oct. 10, 1927.

*Type*.—Collected in Valle de la Trinidad, Baja California, Mexico (lat. 31°20' north; long. 115°40' west), by L. M. Huey, July 13, 1927; male adult, skin and skull, no. 6308, San Diego Soc. Nat. Hist.

*Range*.—Known only from the type locality, Trinidad Valley, Baja California (fig. 19). *Zonal range*: Lower Sonoran.

*External characters*.—Similar to *C. t. tereticaudus* but slightly darker (more brownish).

*Cranial characters*.—Skull similar to that of *tereticaudus* but averaging longer, with relatively longer nasals.

*Color* (July specimens).—Upper parts nearly uniform cinnamon drab; sides of nose and face washed with fuscous; feet buffy white; tail above, cinnamon drab at base, the distal half fuscous tipped with pale buff; tail beneath, pale pinkish buff; under parts white.

*Measurements*.—Average of 7 adults and 3 subadults (*vide* Huey): Total length, 244.4 (240–260); tail vertebrae, 90.3 (83–98); hind foot, 37 (35–39). *Skull*: Average of 17 adults (7 males, 10 females): Greatest length 37.5 (36.3–38.5); palatilar length, 17.2 (17–18); zygomatic breadth, 22.9 (21.8–23.9); cranial breadth, 17.9 (17.3–18.5); interorbital breadth, 8.7 (8–9.3); postorbital constriction, 13 (11.7–13.6); length of nasals, 12.6 (11.9–13.2); maxillary tooth row, 7.8 (7.2–8.2).

*Remarks*.—This subspecies is a slightly differentiated form living in a narrow valley at the north end of the San Pedro Martir Range, at an elevation of about 2,500 feet, on the Pacific slope (Huey, l. c.); the limits of its range are not known.

*Specimens examined*.—Total number, 28, from type locality.<sup>19</sup>

## Subgenus CALLOSPERMOPHILUS Merriam

[Characters on p. 45]

## COLOR PATTERN

In most forms of this group the color pattern consists of a longitudinal white stripe on each side of the back, bordered on each side by a black stripe; in some races the inner black stripes are absent or much reduced in extent and the outer black stripes may also be reduced. Most of the races, in summer pelage, have a more or less distinct "mantle" covering the head and shoulders, varying in color from cinnamon buff to tawny or russet; the median dorsal area is some shade of gray, buff, cinnamon, or fawn.

## PELAGE AND MOLT

The pelage is dense and soft, the bases of the hairs plumbeous.

Apparently there is but one molt annually, occurring usually during June or the first half of July, but in some cases not until the middle of August. By the following spring, the pelage often shows a considerable amount of wear and the rich colors of the head and shoulders often have faded to a much paler shade, so that specimens

<sup>19</sup> Twenty-six in collection San Diego Soc. Nat. Hist.

in this condition present a very different appearance from those in fresh pelage. No evidence of a molt in the fall has been discovered.

#### KEY TO SPECIES AND SUBSPECIES

(Based on typical adults in summer pelage)

- a*<sup>1</sup>. Median pair of dark dorsal stripes prominent.
- b*<sup>1</sup>. Under side of tail paler (cinnamon buff or pinkish cinnamon).
- c*<sup>1</sup>. Mantle darker and more extensive..... *tescorum* (p. 199)
- c*<sup>2</sup>. Mantle paler and less extensive..... *cinerascens* (p. 198)
- b*<sup>2</sup>. Under side of tail darker (tawny or russet).
- c*<sup>1</sup>. Mantle darker (russet).
- d*<sup>1</sup>. Rump darker (natal brown)..... *trinitatis* (p. 211)
- d*<sup>2</sup>. Rump paler (army brown or fawn color).
- e*<sup>1</sup>. Color of mantle extending to the fore back.
- f*<sup>1</sup>. Dorsal area smoke gray..... *mitratus* (p. 210)
- f*<sup>2</sup>. Dorsal area fawn color..... *connectens* (p. 205)
- e*<sup>2</sup>. Color of mantle not extending to the fore back..... *castanurus* (p. 201)
- c*<sup>2</sup>. Mantle paler (ochraceous tawny or mikado brown).
- d*<sup>1</sup>. Hind feet buffy.
- e*<sup>1</sup>. Under parts buffy..... *chrysoedirus* (p. 203)
- e*<sup>2</sup>. Under parts whitish..... *bernardinus* (p. 209)
- d*<sup>2</sup>. Hind feet whitish.
- e*<sup>1</sup>. Tail paler beneath (tawny).
- f*<sup>1</sup>. Head darker (hazel)..... *trepidus* (p. 206)
- f*<sup>2</sup>. Head paler (mikado brown)..... *caryi* (p. 197)
- e*<sup>2</sup>. Tail darker beneath (russet)..... *certus* (p. 208)
- a*<sup>2</sup>. Median pair of dark dorsal stripes absent or much reduced.
- b*<sup>1</sup>. Tail more than 70 mm.
- c*<sup>1</sup>. Size larger (hind foot, 43-49 mm); under parts darker..... *saturatus* (p. 212)
- c*<sup>2</sup>. Size smaller (hind foot, 40-44 mm); under parts paler.
- d*<sup>1</sup>. Upper parts paler (light pinkish cinnamon)..... *wortmani* (p. 195)
- d*<sup>2</sup>. Upper parts darker (pinkish cinnamon or fawn).
- e*<sup>1</sup>. Tail paler beneath..... *lateralis* (p. 191)
- e*<sup>2</sup>. Tail darker beneath..... *arizonensis* (p. 196)
- b*<sup>2</sup>. Tail less than 70 mm..... *madrensis* (p. 213)

#### CITELLUS LATERALIS (SAY)

[Synonymy under subspecies]

*Specific characters*.—Size small to medium; hind foot, 35-46 mm; tail, 63-118; skull length, 39.6-45.6. Color pattern as usual in the subgenus (see p. 190), but coloration variable. Except for size and proportions, there are no characters to separate *lateralis* from the two outlying species—*C. saturatus* and *C. madrensis*—and if the ranges of these adjoined the range of any of the races of *lateralis*, they would probably be found to intergrade with the latter.

There are, however, two groups in the species *lateralis*, one group containing the subspecies *lateralis*, *arizonensis*, and *wortmani*, characterized by the absence or reduced extent of the inner pair of dark dorsal stripes, and the other group, comprising the remaining 11 races, in which these stripes are prominent.

#### CITELLUS LATERALIS LATERALIS (SAY)

SAY'S MANTLED GROUND SQUIRREL

(Pls. 27, D; 32, D)

*S[ciurus] lateralis* Say, Long's Exped. Rocky Mountains, 2: 46, 1823.

*Arctomys (Spermophilus) lateralis* Richardson, Zool. Jour. 3: 519, 1828.

*Spermophilus lateralis* F. Cuvier, Sup. à l'hist. natur. Buffon, Mamm. 1: 335,

*Tamias lateralis* Allen, Boston Soc. Nat. Hist. Proc. 16: 290, 1874.

*Callospermophilus lateralis* Merriam, Wash. Acad. Sci. Proc. 3: 563, 1901.

*Citellus* (*Callospermophilus*) *lateralis* Allen, Brooklyn Inst. Mus., Sci. Bull. 1: 119, 1905.

*Type*.—None designated; description apparently based on a specimen taken by Long's Expedition on the Arkansas River near Canon

City, Colo.; a specimen said to be "preserved in the Philadelphia Museum." (Say, 1823, p. 47.)

*Range*.—South-central Wyoming, central and western Colorado, eastern Utah, northern Arizona, and northern New Mexico; north to southern Fremont County, Wyo. (Miners Delight); east to the foothills of the Rocky Mountains in Colorado and New Mexico; south to San Miguel County, N. Mex. (upper Pecos River); west to the Beaver Mountains, Utah, and the Kaibab Plateau, Ariz. (fig. 20). *Zonal range*: Transition, Canadian, and Hudsonian.

*External characters*.—Head and face mikado brown or pinkish cinnamon (paler than in *C. l. castanurus* and *C. l. cinerascens*); shoulders tawny; mantle not well defined; inner pair of black dorsal stripes obsolete or much reduced; under side of tail pinkish buff or pinkish cinnamon (similar to that of *cinerascens*).

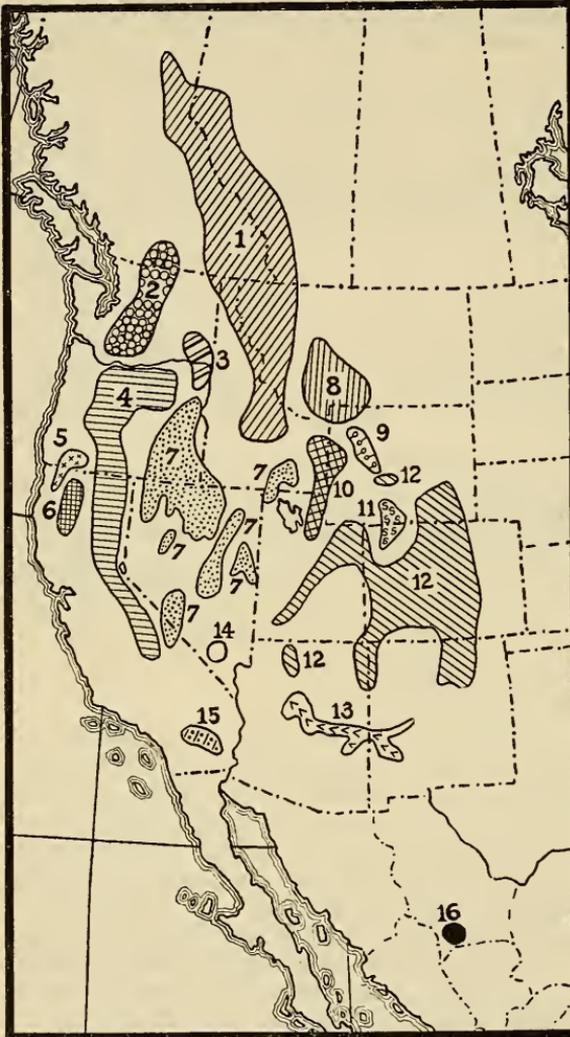


FIGURE 20.—Distribution of *Citellus saturatus* and *C. madrensis* and of the subspecies of *C. lateralis* (subgenus *Callospermophilus*): 1, *C. l. tesorum*; 2, *C. saturatus*, 3, *C. l. connectens*; 4, *C. l. chrysoideirus*; 5, *C. l. trinitatis*; 6, *C. l. mitratus*; 7, *C. l. trepidus*; 8, *C. l. cinerascens*; 9, *C. l. caryi*; 10, *C. l. castanurus*; 11, *C. l. wortmani*; 12, *C. l. lateralis*; 13, *C. l. arizonensis*; 14, *C. l. certus*; 15, *C. l. bernardinus*; 16, *C. madrensis*.

*Cranial characters*.—Skull about the size of that of *cinerascens*; nasals longer, extending considerably beyond the posterior border of the premaxillae.

*Color.*—*Summer pelage* (Specimens from Boulder and Estes Park, Colo.): Head and face pinkish cinnamon or mikado brown; eye ring buffy white; shoulders and sides of neck tawny, mikado brown, or cinnamon; ears pinkish cinnamon, margined with pale buff; dorsal area pinkish cinnamon, more or less mixed with light smoke gray (the gray sometimes predominating); rump and thighs fawn color; lateral stripes creamy white or pinkish buff, bordered beneath by a shorter black stripe; lower sides from shoulders to rump, pinkish buff or pale pinkish buff; feet creamy white or pinkish buff; tail above, fuscous black, mixed with pinkish buff or pinkish cinnamon; tail beneath, pinkish buff or pinkish cinnamon; under parts creamy white or pale pinkish buff. *Winter pelage* (Specimens from Lake City, Colo., Sept. 17; Bridger Pass, Wyo., May 9): Shoulders and sides of neck pinkish buff, more or less mixed with cinnamon and fuscous; otherwise about as in summer pelage.

*Molt.*—The molt takes place usually in June and July; a male specimen from Boulder, Colo., June 11, shows new pelage covering the head, shoulders, and most of the back and under parts, the lower sides, rump, and hinder back still retaining the old worn winter pelage; a male from Cascade, Colo., June 28, has nearly completed the spring molt; another male from Coulter, Colo., July 10, shows new pelage covering the anterior two-thirds of the body, the remainder being in badly worn winter pelage. In young individuals and breeding females, the molt is often delayed until August; two immature specimens from Estes Park, Colo., taken on July 30 and August 27, respectively, show new pelage covering the anterior half of the body; an adult female from Hermit, Colo., July 31, is still in worn winter pelage, except for small patches of fresh hair on the head; another breeding female from Estes Park, August 12, shows a molt beginning on the head and the middle of the back.

*Measurements.*—Average of 10 adult males from Colorado and northern New Mexico: Total length, 273 (254–292); tail vertebrae, 92 (81–107); hind foot, 42.6 (41–44); ear from notch (dry), 14.4 (14–15). Average of 10 adult females from same localities: Total length, 275 (252–293); tail vertebrae, 95.8 (83–106); hind foot, 41.5 (40–43); ear from notch, 14.5 (13–16). *Skull:* Average of 10 adult males from Colorado and northern New Mexico: Greatest length, 43.9 (42.9–45.5); palatilar length, 20.2 (19.5–21); zygomatic breadth, 27.3 (26.2–27.9); cranial breadth, 20 (19.3–20.5); interorbital breadth, 10.5 (10–11.1); postorbital constriction, 12.7 (12–13.4); length of nasals, 16.4 (15.1–17.5); maxillary tooth row, 8.6 (8.3–9.4). Average of 10 adult females from same region: Greatest length, 43.3 (42.1–44.4); palatilar length, 20.1 (19.5–20.5); zygomatic breadth, 27.3 (26.3–28.3); cranial breadth, 19.9 (19.3–20.3); interorbital breadth, 10.2 (9.6–11.3); postorbital constriction, 12.7 (11.8–13.5); length of nasals, 15.9 (15.2–17); maxillary tooth row, 8.4 (7.8–9.2).

*Weight.*—Hatt (1927, p. 3) gives the average weight of 5 males as 242.4 g (212–275) and of 5 females as 220.2 g (167–264).

*Remarks.*—Say's ground squirrel, the first member of the group to be discovered, has a wide range in the southern Rocky Mountain region and westward over a large part of Utah. With the subspecies *wortmani* and *arizonensis* it forms a well-marked group, characterized by a rather dull-colored mantle, and partial or complete suppression of the interior pair of black dorsal stripes. It differs widely in these characters from *C. l. castanurus* and no intergrades between the two are known; however, intergradation with *C. l. caryi* is clearly shown by a series of four specimens from Big Sandy, Wyo.; three

of these resemble *lateralis* in the color of the under surface of the tail, but differ in having the inner pair of black stripes well-developed in two individuals, shorter in the other two; their skulls are large, agreeing with those of *lateralis*. Thus the two groups—*lateralis* and *chrysodeirus*—long supposed to be distinct, are now shown to consist of a single species, separable into 14 races.

*Specimens examined*.—Total number, 295, as follows:

- Arizona:** Kaibab National Forest, 23 (V. T. Park, 17; Jacob Lake, 4; Greenland Spring, 2); Fort Defiance (12 miles northwest, at 7,800 feet altitude), 4; Lukachukai Mountains, 13; Tunitcha Mountains, 12.
- Colorado:** Boulder, 3; Boulder County, 6; Boulder Pass, 1; Buckhorn Ranger Station, 2; Buena Vista, 2;<sup>20</sup> California Gulch, 1; Cascade (El Paso County), 4; Castle Rock (10 miles southwest), 4;<sup>20</sup> Coulter, 2; Dayton (on Twin Lakes), 2; Douglas Spring (Routt County), 5;<sup>21</sup> Elk Mountains, 1; Escalante Hills (20 miles southeast of Lodore), 1; Estes Park, 18; Evergreen, 1; Garo (Park County), 1; Gold Hill, 7; Hahns Peak (Routt County), 1; Hermit (San Juan County), 2; Idaho City (=Idaho Springs), 4; Jefferson County, 1; Lake City, 2; La Veta, 1;<sup>20</sup> Longs Peak, 5; Manitou, 3;<sup>20</sup> Marvine (Rio Blanco County), 1; Mears (Chaffee County), 1;<sup>21</sup> Meeker, 1; Monshower Meadows (3 miles west of Cochetopa Pass), 1; North Park, 2; Pagosa Springs, 3; Pearl (Jackson County), 1; Pikes Peak (10,000 feet altitude), 1; Rabbit Ear Mountains (Grand County), 3; Rangely (Rio Blanco County), 1; Rifle, 1; Rio Blanco (Rio Blanco County), 2; Saguache Park, 1; Steamboat Springs (15 miles west), 1; Toponas, 1;<sup>22</sup> Ward (Boulder County), 1; Westcliffe (Custer County), 1; White River (20 miles east of Rangely), 1.
- New Mexico:** Baldy Mountain (Colfax County), 1;<sup>22</sup> Catskill (Colfax County), 1; Chuska Mountains, 4; Cimarron (Colfax County), 2;<sup>22</sup> Costilla Pass (Colfax County), 2; Coyote Creek (8,400 feet altitude, Mora County), 1; Halls Peak (Mora County), 1; Hondo Canyon (Santa Fe County), 5; Hopewell (8 miles west, Rio Arriba County), 1; Jemez Mountains, 3; Long Canyon (3 miles north of Catskill, Colfax County), 3; Martinez (Colfax County), 1; Pecos (10 miles north), 1; Pecos Baldy (12,000 feet altitude), 2; Pajado Canyon (Colfax County), 1; Red River (Taos County), 1;<sup>22</sup> Santa Fe, 1; Santa Fe Canyon, 2;<sup>20</sup> Taos Mountains, 1; Tierra Amarilla, 1; Tres Piedras (Taos County), 13; Willis (near Cowles, San Miguel County), 5.
- Utah:** Beaver Creek (4 miles south of Lonetree, Wyo.), 2; Beaver Mountains, 21 (Britts Meadows, 17;<sup>23</sup> Mount Delano, 1; Petty Mountain (15 miles north of Mountain Home), 1;<sup>27</sup> Puffer Lake, 2; Currant Creek, Uinta National Forest, 1; Ephraim, 4; Fish Lake National Forest, 3;<sup>24</sup> Junction of Green and White Rivers, 3;<sup>27</sup> Manila (10 miles southeast), 1;<sup>27</sup> Parowan Mountains (Brian Head), 1; Uinta Mountains, Gilbert Peak (10,000 feet altitude), 1; Uinta Mountains (Daggett County), 15;<sup>20</sup> Vernal, 4;<sup>25 27</sup> White-rocks, 1.
- Wyoming:** Big Sandy, 4; Bridger Pass (Carbon County), 3; Islay (6 miles west, Laramie County), 1; Laramie Mountains, 1; Maxon (Sweetwater County), 1; Medicine Bow Mountains, 2; Miners Delight (3 miles northeast of Atlantic City, Fremont County), 1; Pole Mountain (15 miles southeast of Laramie), 3; Sherman (Albany County), 1;<sup>29</sup> Sierra Madre Mountains (south base Bridger Peak), 3; South Pass City (6 miles north, Fremont County), 1; Springhill (12 miles north of Laramie Peak), 2; Woods P. O. (4 miles north of Jelm, Albany County), 5.

<sup>20</sup> Univ. Michigan Mus. Zool.

<sup>21</sup> E. R. Warren collection.

<sup>22</sup> Cleveland Mus. Nat. Hist.

<sup>23</sup> Three in Amer. Mus. Nat. Hist., four in Mus. Vert. Zool.

<sup>24</sup> Utah State Agr. College.

<sup>25</sup> Mus. Vert. Zool.

<sup>26</sup> Amer. Mus. Nat. Hist.

<sup>27</sup> Carnegie Mus.

## CITELLUS LATERALIS WORTMANI (ALLEN)

## WORTMAN'S MANTLED GROUND SQUIRREL

*Tamias wortmani* Allen, Amer. Mus. Nat. Hist. Bull. 7: 335, Nov. 8, 1895.  
 [*Spermophilus wortmani* Elliot, Field Columb. Mus. Pub., Zool. Ser. 2: 84, 1901.  
*Citellus wortmani* Elliot, Field Columb. Mus. Pub., Zool. Ser. 6: 107, 1905.  
*Callospermophilus wortmani* Cary, Biol. Soc. Wash. Proc. 20: 86, 1907.  
*Callospermophilus lateralis wortmani* Cary, North Amer. Fauna 33: 84, 1911.

*Type*.—Collected at Kinney Ranch, Bitter Creek, Sweetwater County, Wyo., July 13, 1895, by Walter W. Granger; male adult, skin and skull, no.  $\frac{1}{9} \frac{10}{3} \frac{5}{5} \frac{7}{2}$ , Amer. Mus. Nat. Hist.

*Range*.—Deserts and badlands in south-central Wyoming and northwestern Colorado; north to Steamboat Mountain, Sweetwater County, Wyo.; south to Bear River Valley, Routt County, Colo. (fig. 20). *Zonal range*: Upper Sonoran.

*External characters*.—Similar to *C. l. lateralis* but of paler coloration. Compared with *C. l. caryi*: Inner pair of black dorsal stripes absent or very faintly indicated; colors paler, especially of the head, shoulders, and under side of tail.

*Cranial characters*.—Skull closely similar to that of *lateralis*, but averaging slightly larger, except the nasals, which are shorter.

*Color*.—*Summer pelage*: Top of head pinkish cinnamon or vinaceous cinnamon; eye ring buffy white; stripe beneath the eye reaching to the ear, sayal brown; ears cinnamon, shading to pinkish buff on posterior border; shoulders and sides of neck cinnamon; sides of nose and lower cheeks pinkish buff; dorsal area pinkish buff or light pinkish cinnamon, faintly shaded with fuscous (the bases of the hairs fuscous); lateral stripes pinkish buff, bordered beneath with a shorter black stripe, which latter is sometimes partly obscured by cinnamon; lower sides pinkish buff; rump same color as the back; thighs cinnamon buff or mikado brown; feet pinkish buff; tail above, fuscous black, mixed with pinkish buff; tail beneath, warm buff; under parts pinkish buff.

*Molt*.—The summer molt occurs in July; an adult male taken on Bitter Creek, Wyo., July 7, had nearly completed the molt, new pelage covering the anterior portion of the body and the tail, leaving the rump with the old worn pelage; adult females taken July 5, and 9, are in badly worn winter pelage with a small patch of new hair appearing in the middle of the back.

*Measurements*.—Average of 6 adults (2 males, 4 females) from type locality: Total length, 280 (271–289); tail vertebrae, 95 (87–101); hind foot, 43.2 (41–44); ear from notch (dry), 17.1 (16–18). *Skull*: Average of 6 adults (2 males, 4 females): Greatest length, 44.1 (43.4–46); palatilar length, 20.4 (20–21); zygomatic breadth, 27.9 (27.4–28.5); cranial breadth, 20.4 (20.2–20.7); interorbital breadth, 10.3 (9.9–10.9); postorbital constriction, 13 (12.5–13.8); length of nasals, 15.6 (15.2–16.2); maxillary tooth row, 8.7 (8.3–9.1).

*Remarks*.—This pale race is confined to a rather restricted area of desert country, and its range is almost entirely surrounded by the range of *lateralis*.

*Specimens examined*.—Total number, 50, as follows:

Colorado: Snake River (5–7 miles above Lily), 5; <sup>28</sup> Snake River (20 miles below Baggs, Wyo.), 1.

Utah: Uncompahgre Indian Reservation, 1.<sup>29</sup>

Wyoming: Bitter Creek (Kinney Ranch, Sweetwater County), 42; <sup>29</sup> Superior, 1.

<sup>28</sup> E. R. Warren collection.

<sup>29</sup> Amer. Mus. Nat. Hist.

## CITELLUS LATERALIS ARIZONENSIS (BAILEY)

## ARIZONA MANTLED GROUND SQUIRREL

*Callospermophilus lateralis arizonensis* Bailey, Biol. Soc. Wash. Proc. 26: 130, May 21, 1913.

*Citellus lateralis arizonensis* Elliot, Check-list Mamm. North Amer., Sup., p. 30, 1917.

*Type*.—Collected near Little Spring, San Francisco Mountain, Ariz. (altitude 8,250 feet), August 8, 1889, by C. Hart Merriam and Vernon Bailey; male adult, skin and skull, no.  $\frac{17527}{24463}$ , U. S. Natl. Mus. (Biological Survey collection) (orig. no. 308).

*Range*.—Mountains and high plateaus in central and eastern Arizona and west-central New Mexico; north to San Francisco Mountain, Ariz.; east and south to the Mimbres Mountains, N. Mex. (fig. 20). *Zonal range*: Transition and Canadian.

*External characters*.—Similar in summer pelage to *C. l. lateralis*, but slightly deeper colored on head and thighs; tail grizzled beneath with blackish and usually lacking a clear yellowish median area.

*Cranial characters*.—Skull closely similar to that of *lateralis*.

*Color*.—*Summer pelage*: Top of head and face hazel or vinaceous cinnamon; shoulders tawny; dorsal area mixed pinkish cinnamon and pale smoke gray, shading on rump and thighs to mikado brown or russet; light dorsal stripes from shoulders to hips, pinkish buff or warm buff; outer pair of dark stripes about as broad as the light stripes, but shorter; inner pair of dark stripes nearly obsolete; sides of body and under parts pinkish buff or warm buff; front feet and legs cinnamon or cinnamon buff, shaded with pinkish buff; hind feet pinkish buff, often washed with some of the russet color of the legs; tail above, fuscous black, mixed with ochraceous buff or pinkish buff; tail beneath, ochraceous buff or pale cinnamon buff, more or less mixed with fuscous black. *Winter pelage* (October 31): Nose and front of face cinnamon; upper parts from crown to rump smoke gray, shaded with pale buff on hinder back; thighs mikado brown; tail above, fuscous black, mixed with pale pinkish buff; inner pair of black dorsal stripes present on middle of back, but narrower than outer pair (which are likewise short); light dorsal stripes dull creamy white; feet and under parts creamy white.

*Molt*.—An adult female from San Francisco Mountain, August 13, is acquiring a new pelage on the head, shoulders, and middle of the back; doubtless the molt begins earlier than that date in most cases, but with the material at hand it is not possible to determine the usual time.

*Measurements*.—Average of 17 adults (10 males, 7 females) from type locality: Total length, 277.6 (265–292); tail vertebrae, 98 (90–106); hind foot, 41.7 (40–44); ear from notch (dry), 14.2 (13–15.5). *Skull*: Average of 10 adults (5 males, 5 females) from type locality: Greatest length, 43.8 (42.9–44.6); palatilar length, 20.1 (19.5–21); zygomatic breadth, 27.7 (26.8–28.6); cranial breadth, 19.8 (19.4–20.7); interorbital breadth, 10.6 (10.2–11.5); postorbital constriction, 13.2 (12.6–14.3); length of nasals, 15.9 (15.4–16.8); maxillary tooth row, 8.4 (8–8.8).

*Weight*.—Hatt (1927, p. 3) gives the average weight of 8 females as 229.8 g (177–270); two males weight 200 and 220 g, respectively.

*Remarks*.—This race is a slightly marked form, occupying an area isolated from the typical race, *lateralis*.

*Specimens examined*.—Total number, 120, as follows:

**Arizona:** Alpine (Apache County), 4; "Apache" (=Ord Peak), 1; Baker Butte (Mogollon Mesa), 7; Flagstaff, 29; Hart Prairie (12 miles north of Flagstaff), 2; Little Spring (18 miles northwest of Flagstaff), 1; Montezuma Well (Yavapai County), 1; Mount Thomas, 10; Prieto Plateau (Greenlee County), 7; San Francisco Mountain, 46; Springerville, 4; White Mountains, 4 (Horseshoe Cienega, 3; Marsh Lake, 1); Williams, 1.

**New Mexico:** Mimbres River (head), 1; Mimbres Mountains (Big Rocky Creek), 1; Luna (Catron County), 1.

CITELLUS LATERALIS CARYI (HOWELL)

CARY'S MANTLED GROUND SQUIRREL

*Callospermophilus lateralis caryi* Howell, Biol. Soc. Wash. Proc. 30: 105, May 23, 1917.

*Type*.—Collected 7 miles south of Fremont Peak, Wind River Mountains, Wyo. (10,400 feet altitude), July 19, 1911, by Merritt Cary; female adult, skin and skull, no. 176826, U. S. Natl. Mus. (Biological Survey collection) (orig. no. 2211).

*Range*.—Wind River Mountains, Wyo., and parts of Gros Ventre Range; north (apparently) to Wildcat Ridge, south of Yellowstone Park (fig. 20). *Zonal range*: Canadian and Hudsonian.

*External characters*.—Similar to *C. l. castanurus*, but paler and more grayish on the back; under side of tail paler. Compared with *C. l. lateralis*: Head and shoulders in summer pelage darker and more extensively tawny; inner pair of black dorsal stripes well developed (nearly obsolete in *lateralis*); under side of tail darker (tawny or clay color). Compared with *C. l. cinerascens*: Size smaller; under side of tail clear tawny instead of cinnamon buff.

*Cranial characters*.—Skull closely similar to that of *castanurus*; smaller than those of *lateralis* and *cinerascens*.

*Color*.—*Summer pelage*: Top and sides of head mikado brown or sayal brown; lower cheeks cinnamon buff; eye ring white; shoulders and sides of neck mikado brown; median dorsal area, from nape to tail, light drab, more or less shaded with pinkish cinnamon or pinkish buff; lateral stripes white or creamy white, reaching from the ears to the rump, bordered above and below by black stripes of about the same width, reaching from the shoulders nearly to the hips (the inner pair shorter and sometimes narrower); lower sides pinkish buff; feet whitish or faintly washed with cinnamon buff; tail above, black, more or less mixed with cinnamon buff or cartridge buff; tail beneath, tawny or clay color, edged with cartridge buff or cinnamon buff; under parts creamy white. *Winter pelage* (May 16): Head fawn color; sides of neck pinkish buff; back drab gray; rump and thighs cinnamon drab; light dorsal stripes clear white, extending from ears to rump; sides and under parts grayish white; otherwise as in summer pelage.

*Measurements*.—Average of 8 adults (2 males, 6 females): Total length, 273 (265–282); tail vertebrae, 97 (83–101); hind foot, 40.5 (39–42); ear from notch (dry), 13.4 (12.5–15). *Skull*: Average of 3 adult females: Greatest length, 42 (41.6–42.7); palatilar length, 19.2 (19–19.5); zygomatic breadth, 25.9 (25.8–26); cranial breadth, 18.8 (18.6–18.9); interorbital breadth, 10 (9.7–10.4); postorbital constriction, 12.4 (12.1–13.4); length of nasals, 14.4 (13.8–14.7); maxillary tooth row, 8.5 (8.4–8.7). One adult male from Kendall, Wyo.: 43.6; 20; 26.8; 18.9; 9.5; 12.9; 15.5; 8.

*Remarks*.—This race has a limited range between the ranges of *cinerascens* on the north and *lateralis* on the south. Intergradation

with *lateralis* is shown by a series from Big Sandy (referred to *lateralis*); there is no evidence at present of intergradation with *cinerascens*, but doubtless this does occur; *C. l. caryi* is most nearly related to *castanurus*, with which it intergrades in the Gros Ventre Mountains.

*Specimens examined*.—Total number, 12, as follows:

**Wyoming:** Bobcat Ridge (Teton County), 2; Bull Lake (Fremont County), 1; Fremont Peak (5 miles south, 10,600 feet), 3; Jakeys Creek (5 miles south of Dubois), 3; Lake Fork (Wind River Mountains, 10,600 feet), 3.

#### CITELLUS LATERALIS CINERASCENS (MERRIAM)

##### MERRIAM'S MANTLED GROUND SQUIRREL

*Tamias cinerascens* Merriam, North Amer. Fauna 4: 20, Oct. 8, 1890.

*Tamias lateralis cinerascens* Thompson [Seton], Recreation 8: 365, May 1898.

[*Spermophilus*] *cinerascens* Elliot, Field Columb. Mus. Pub., Zool. Ser. 2: 106, 1901.

*Citellus cinerascens* Elliot, Field Columb. Mus. Pub., Zool. Ser. 6: 106, 1905.

*C[allospermophilus] cinerascens* Warren, Mamm. Colorado, p. 168, 1910.

*Type*.—Collected at Helena, Mont., August 13, 1888, by C. Hart Merriam; female adult, skin and skull, no. 186465, U. S. Natl. Mus. ( $\frac{4525}{3177}$ , Merriam collection) (orig. no. 4).

*Range*.—Outlying ranges in south-central Montana and north-western Wyoming, from Helena south to Yellowstone Park and east to the Beartooth Mountains (fig. 20). *Zonal range*: Canadian and Hudsonian.

*External characters*.—Similar to *C. l. castanurus*, but general tone of upper parts more grayish (less vinaceous); mantle similar in color but sides of face and neck more ochraceous; tail much paler beneath (less tawny); hind foot longer. Compared with *C. l. lateralis*: Upper parts more grayish (less vinaceous); mantle darker (more tawny); median pair of black stripes always present and equaling the outer pair in width; under side of tail paler. Compared with *C. l. tescorum*: Mantle paler and less extensive; tail averaging longer, and paler beneath.

*Cranial characters*.—Skull similar to that of *lateralis* in size and proportions, nasals shorter, reaching but little beyond posterior border of premaxillae; decidedly larger than the skull of *castanurus* or *C. l. chrysodeirus*.

*Color*.—*Summer pelage* (topotypes, August): Top of head, nape, and sides of neck below and behind the ears hazel, bordered next the throat with ochraceous buff or ochraceous tawny; sides of nose, cheeks, and eye ring pale pinkish buff; dorsal area smoke gray, shaded on rump and thighs with mikado brown; lower sides pinkish buff; under parts warm buff varying to pale pinkish buff; feet pinkish buff or creamy white; tail above, fuscous black, edged with cinnamon buff; tail beneath, pinkish buff or pale cinnamon buff, bordered on sides and tip with fuscous black, and edged with cinnamon buff or buffy white. *Winter pelage* (adult female topotype, August 13): Mantle absent; entire head, nape, back, and rump, smoke gray; dorsal stripes as usual, sides ivory yellow; tail much as in summer, but usually more mixed with blackish, and lacking the clear pinkish buff of the summer pelage.

*Molt.*—The molt evidently occurs in late summer, as indicated by the presence of adult females in winter pelage on August 13 at Helena; a female from Pahaska Tepee, Wyo., August 3, shows new summer pelage covering the head to a line a short distance back of the ears.

*Measurements.*—Average of 4 adults (1 male, 3 females) from Yellowstone Park and vicinity: Total length, 286 (270–297); tail vertebrae, 107 (95–118); hind foot, 43.6 (41–46); ear from notch (dry), 14.9 (14–16). *Skull:* One adult male from Helena, Mont.: Greatest length, 45.6; palatilar length, 21; zygomatic breadth, 28.2; cranial breadth, 20.4; interorbital breadth, 11; postorbital constriction, 12.7; length of nasals, 15.6; maxillary tooth row, 8.2. Average of 4 adult females from Helena and Emigrant Gulch, Mont., and Yellowstone Park, Wyo.: Greatest length, 43.9 (42.6–45); palatilar length, 20.1 (19.3–21); zygomatic breadth, 27.5 (26.3–29.3); cranial breadth, 20.1 (19.3–20.8); interorbital breadth, 10.5 (10.2–11); postorbital constriction, 13.3 (12.9–13.7); length of nasals, 14.9 (14.5–15.5); maxillary tooth row, 8.9 (8.7–9.2).

*Remarks.*—This race is most nearly related to *tescorum*, but differs from it in the paler color of the mantle and in the slightly longer tail, which is clearer yellow beneath. The series available from the type locality is inadequate to show the range of variation in summer pelage and the exact limits of range of the subspecies are still to be worked out after more thorough collecting in Montana.

*Specimens examined.*—Total number 28, as follows:

**Montana:** Beartooth Mountains, 2; Butte (12 miles east), 6; Deer Lodge County, 3;<sup>30</sup> Emigrant Gulch (near Emigrant Peak, Park County), 1; Helena, 8.

**Wyoming:** Pahaska Tepee (Whirlwind Peak), 3; Yellowstone Park, 5.

#### CITELLUS LATERALIS TESCORUM (HOLLISTER)

##### HOLLISTER'S MANTLED GROUND SQUIRREL

*Citellus (Callospermophilus) cinerascens* Preble, North Amer. Fauna 27: 166, 1908 (not of Merriam).

*Callospermophilus lateralis tescorum* Hollister, Smithsn. Misc. Collect. 56 (26): 2, Dec. 5, 1911.

*Citellus lateralis tescorum* Elliot, Check-list Mamm. North Amer. Sup., p. 29, 1917.

*Type.*—Collected at head of Moose Pass Branch of the Smoky River, Alberta (near Moose Pass, British Columbia), at 7,000 feet altitude, August 2, 1911, by N. Hollister; male adult, skin and skull, no. 174165, U. S. Natl. Mus.; original number, 3863.

*Range.*—Northern Rocky Mountain region in western Alberta, eastern British Columbia, northern and central Idaho, and western Montana; north to Mount Selwyn, British Columbia; south to Edna and Ketchum, Idaho; west to the Columbia River Valley, southeastern British Columbia (fig. 20). *Zonal range:* Canadian and Hudsonian.

*External characters.*—Similar to *C. l. cinerascens*, but mantle darker and more extensive, reaching over the shoulders and in some specimens nearly to the middle of the back; under side of tail averaging darker.

*Cranial characters.*—Skull closely similar to that of *cinerascens*; much larger than that of *C. l. castanurus*.

<sup>30</sup> Kansas Univ. Mus.

*Color.*—Head, neck, and shoulders russet, varying to mars brown; median dorsal area smoke gray, shaded on the rump with dull mars brown or vandyke brown, this color nearly solid on the thighs; eye ring creamy white; light dorsal stripes creamy white, shaded with pale pinkish buff; inner pair of black stripes nearly as wide as outer pair, but not reaching quite so far back; sides pinkish buff or warm buff; under parts pinkish buff; front feet pinkish buff; hind feet pale pinkish buff or buffy white; tail above, black, bordered with cinnamon buff; tail beneath, cinnamon buff or pinkish cinnamon, with a subterminal band of black. *Winter pelage* (Ptarmigan Lake, Alberta, July 9, and St. Mary Lake, Mont., June 5): Head, neck, and median dorsal area smoke gray; ears russet, edged with pinkish buff; sides, under parts, and feet pale pinkish buff; under side of tail pinkish buff or cinnamon buff.

*Variation.*—While the topotype series is quite uniform in the color of the under surface of the tail, the series from northwestern Montana shows more variation, some specimens having a paler tail (about as in *cinerascens*) and others a slightly darker tail, with some admixture of black.

*Molt.*—A male specimen from Canadian National Park, Alberta, July 5, shows fresh summer pelage on the shoulders and crown; two female specimens from Teton County, Mont., June 14 and 19, show new pelage in irregular patches on the head and shoulders; a breeding female from Thompson Falls, Mont., July 27, shows fresh pelage covering the head and ears, the rest of the pelage being in worn condition. A breeding female from Canadian National Park, Alberta, July 12, shows fresh summer pelage covering the head and part of the shoulders; another female from Rocky River, Alberta, August 12, had just begun to molt, the new summer pelage covering only the head and face.

*Measurements.*—Average of 16 adults from near type locality: Total length, 292.5 (264–308); tail vertebrae, 103.5 (94–112); hind foot, 43.1 (40–46); ear from notch, 13.5 (12–15). *Skull*: Average of 10 adult males from near type locality: Greatest length, 44.1 (42.1–46.6); palatilar length, 20.6 (20–21.5); zygomatic breadth, 27.4 (26.2–28.9); cranial breadth, 19.9 (19.2–20.4); interorbital breadth, 10.7 (9.9–12); postorbital constriction, 13.2 (12.5–14); length of nasals, 15.5 (14.7–16.1); maxillary tooth row, 8.6 (8–9.1). Average of 7 adult females: Greatest length, 43.3 (42.3–44.6); palatilar length, 20.2 (20–20.5); zygomatic breadth, 26.9 (26.1–27.3); cranial breadth, 19.4 (19–19.6); interorbital breadth, 10.4 (10–10.7); postorbital constriction, 12.7 (12.3–13); length of nasals, 14.9 (14.3–15.9); maxillary tooth row, 8.4 (8.1–8.7).

*Weight.*—A female from Lost River Mountains, Idaho, weighed 12 ounces.

*Remarks.*—This wide-ranging form was for a long time confused with *cinerascens* until separated by Hollister in 1911. It is one of the largest and most richly colored of all the races. It undoubtedly intergrades with *cinerascens*, but there is no material available to prove such intergradation. It is not strongly differentiated from *cinerascens*, but may be distinguished by its darker and more extensive mantle in summer pelage, and by its darker tail.

*Specimens examined.*—Total number, 279, as follows:

Alberta: Banff, 5; <sup>81</sup>, <sup>82</sup> Burmis, 3; <sup>81</sup> Canadian National Park, 5; <sup>82</sup> Canmore, 3; Grand Cache River (60–70 miles north of Jasper House), 4; Hay River (near head), 1; Henry House (15 miles south), 9; Jasper House, 2;

<sup>81</sup> Nat. Mus. Canada.

<sup>82</sup> Amer. Mus. Nat. Hist.

Jasper Park, 17; <sup>31</sup> Moose Mountain, 3; <sup>31</sup> Moose Pass, 2; Mountain Park, 2; <sup>31</sup> Pobokton River, 1; Ptarmigan Lake, 2; <sup>32</sup> Laggan, 2; Rocky River (east branch), 3; <sup>32</sup> Smoky River (head), 9; Southesk River, 2; <sup>32</sup> Sulphur River, 2; Waterton Lake Park, 11.<sup>31</sup>

**British Columbia:** Barkerville, 11; Glacier, 1; <sup>32</sup> Golden City, 1; <sup>31</sup> Green Mountain (near Rossland), 1; <sup>31</sup> Indian Point Lake, 8; <sup>33</sup> Indian Point Mountain, 2; <sup>34</sup> Jarvis Pass, 1; Jubilee Creek (head, near Barkersville), 1; <sup>33</sup> Moose Pass, 6; Moose River, 4; Mount Old Glory (near Rossland), 5; <sup>31</sup> Mount Selwyn, 3; Parsnip River (head), 3; Rossland, 1; <sup>31</sup> Sukunka River, 5; Trail, 2; <sup>31</sup> Wapiti River (head), 1; Yahk, 4; <sup>31</sup> Yellowhead Lake, 1; Yellowhead Pass, 1.

**Idaho:** Birch Creek (mountains west), 6; Bitterroot Mountains, 1; <sup>32</sup> Edna, 11; Elk Summit (Valley County), 2; Goldburg (10 miles west), 2; Ketchum, 6; Lakeview, 2; <sup>36</sup> Lost River Mountains, 28; Mullan, 16; Patterson, 1; Redfish Lake, 2; "Salmon River Mountains" (=Lemhi Mountains), 7; Summit (at Trail Creek, Blaine County), 2; Warren, 1; Wood River (head, Blaine County), 2.

**Montana:** Bass Creek (near Stevensville), 1; Bear Creek (Great Northern R. R., Flathead County), 1; Florence, 4; <sup>35</sup> "Horse Plains" (=Plains), 10; Lake Como (Ravalli County), 1; Lolo Hot Springs, 1; Nyack (Flathead County), 2; Prospect Creek (near Thompson Falls), 3; St. Mary Lake, 3; Summit (Great Northern R. R., Flathead County), 1; Thompson Falls, 11; Thompson Pass, 2.

### CITELLUS LATERALIS CASTANURUS (MERRIAM)

#### WASATCH MANTLED GROUND SQUIRREL

*Tamias castanurus* Merriam, North Amer. Fauna 4: 19, Oct. 8, 1890.

[*Spermophilus*] *castanurus* Elliot, Field Columb. Mus. Pub., Zool. Ser. 2: 84, 1901.

*Citellus castanurus* Elliot, Field Columb. Mus. Pub., Zool. Ser. 6: 106, 1905.

*Callospermophilus castanurus* Lyon and Osgood, U. S. Natl. Mus. Bull. 62: 173, 1909.

*Type*.—Collected at Park City, Wasatch Mountains, Summit County, Utah, July 3, 1890, by Vernon Bailey; female adult, skin and skull, no.  $\frac{22733}{30197}$ , U. S. Natl. Mus. (Biological Survey collection) (orig. no. 1383).

*Range*.—Mountains of extreme western Wyoming, southeastern Idaho, and north-central Utah; north to the Teton Range, Wyo.; east to the Gros Ventre and Salt River Ranges, Wyo.; south in the Wasatch Range to Wasatch County, Utah (and probably farther); west to mountains east of Inkom, Idaho (fig. 20). *Zonal range*: Canadian and Hudsonian.

*External characters*.—Compared with *C. l. lateralis*: Head and mantle darker; black dorsal stripes much more prominent, the inner pair always present and equal in breadth to outer pair; under side of tail darker (more tawny). Compared with *C. l. cinerascens*: General tone of upper parts more vinaceous (less grayish); sides of face and neck less ochraceous; tail much darker. Similar to *C. l. connectens* and *C. l. trepidus*, but sides of face and neck darker (more brownish); tail darker beneath.

*Cranial characters*.—Skull similar to that of *trepidus* but averaging slightly smaller, and relatively narrower across zygomata; decidedly smaller than that of *cinerascens* or of *lateralis*.

<sup>31</sup> Nat. Mus. Canada.

<sup>32</sup> Amer. Mus. Nat. Hist.

<sup>33</sup> Mus. Vert. Zool.

<sup>34</sup> Provincial Mus., Victoria, British Columbia.

<sup>35</sup> Montana State College.

<sup>36</sup> Carnegie Mus.

*Color.*—*Fresh summer pelage:* Head, nape, ears, shoulders, and sides of neck mikado brown, shaded with cinnamon and bordered on the throat with cinnamon buff; median dorsal area and rump fawn color, sprinkled with grayish white; light dorsal stripes pinkish buff; sides light ochraceous buff; fore feet and legs pinkish buff or cinnamon buff; hind legs and thighs mikado brown, the feet pale pinkish buff; tail above, black, bordered with cinnamon buff; tail beneath, russet, the hairs edged with cinnamon buff and with a subterminal band of black; under parts pinkish buff or buffy white.

*Molt.*—An adult female from Park City, Utah, July 4, was acquiring fresh pelage on the head, shoulders, and middle of the back; another from the Salt River Mountains, Wyo., August 21, was still carrying old, moderately worn pelage over most of the body excepting the head, where new pelage is appearing.

*Measurements.*—Average of 8 adult males from type locality: Total length, 272 (256–293); tail vertebrae, 97.1 (85–110); hind foot, 41.5 (39–44). Average of 10 adult females from type locality: 271 (256–280); 95.7 (91–101); 40.4 (38.5–42); ear from notch (dry), 15 (14–17). *Skull:* Average of 10 adult males from type locality: Greatest length, 42.3 (40.2–44.2); palatilar length, 19.8 (19–21); zygomatic breadth, 26.3 (25.4–27.3); cranial breadth, 19.4 (18.8–20.1); interorbital breadth, 9.7 (8.9–10.2); postorbital constriction, 12.5 (11.8–13.1); length of nasals, 14.6 (13.5–16); maxillary tooth row, 8.1 (7.3–8.7). Average of 10 adult females from type locality: Greatest length, 41.9 (40.4–42.8); palatilar length, 19.5 (18.5–20); zygomatic breadth, 25.8 (25.4–26.8); cranial breadth, 19.1 (18.5–19.8); interorbital breadth, 9.8 (9–10.9); postorbital constriction, 12.7 (12.1–13.7); length of nasals, 14.5 (13.6–15.3); maxillary tooth row, 7.9 (7.1–8.4).

*Remarks.*—This race clearly belongs in the *chrysoideirus* group, intergrading with subspecies *trepidus* in southern Idaho. A series of 11 specimens from Rabbit Creek, 8 miles northeast of Inkom, are paler than typical *castanurus*, although their tails are about as dark; one specimen from the Bannock Range, west of Swan Lake, has a paler tail and is best referred to *trepidus*. *C. l. castanurus* is widely different from *lateralis* and although their ranges nearly meet in northern Utah, no evidence of intergradation has been found. It intergrades, however, with *C. l. caryi* in the Gros Ventre Range and probably with *cinerascens* at the northern end of the Teton Range, Wyo. An immature specimen from Moose Creek, in that range, differs from typical *castanurus* in having the under side of the tail a paler shade of red, perhaps indicating an approach to *cinerascens*. Nine specimens from near the head of Twin Creek, in the Gros Ventre Range, Wyo., taken by Arthur B. Fuller and W. P. Bole, Jr., of the Cleveland Museum, are typical *castanurus*, whereas a single specimen taken by H. E. Anthony, 12 miles northwest of Kendall—and thus in practically the same region—shows approach to *caryi* in its paler tail.

*Specimens examined.*—Total number, 112, as follows:

**Idaho:** Big Hole Mountains, 1; Crow Creek (Preuss Mountains), 2; Inkom (8 miles northeast), 11.

**Utah:** Barclay (Salt Lake County), 11; Blacksmiths Fork (Cache County), 2; Bear Lake (east side), 4; Logan Canyon (Cache County), 3;<sup>87</sup> Park City (Summit County), 47; Sardine Canyon (Cache County), 1.<sup>87</sup>

**Wyoming:** Cokeville, 1; Flat Creek (at head, Teton County), 1; Gros Ventre Mountains (head of Twin Creek), 10;<sup>88</sup> Jackson, 5; Kendall (12 miles

<sup>87</sup> Utah State Agr. College.

<sup>88</sup> Cleveland Mus. Nat. Hist.

northwest, Sublette County), 1; La Barge Creek (9,000 feet altitude), 2; Merna (Sublette County), 1; Salt River Mountains, 4; Smiths Fork (head, Lincoln County), 3; Stanley (=Middle Piney Lake), 1; Teton Mountains (south of Moose Creek), 1.

CITELLUS LATERALIS CHRYSODEIRUS (MERRIAM)

GOLDEN-MANTLED GROUND SQUIRREL

(Pl. 11)

*Tamias chrysodeirus* Merriam, North Amer. Fauna 4: 19, Oct. 8, 1890.

*Callospermophilus chrysodeirus* Merriam, North Amer. Fauna 16: 90, 1899.

[*Spermophilus*] *chrysodeirus* Elliot, Field Columb. Mus. Pub., Zool. Ser. 2: 84, 1901.

*Citellus chrysodeirus* Elliot, Field Columb. Mus. Pub., Zool. Ser. 3: 288, 1904.

*Type*.—Collected at Fort Klamath, Oreg., July 31, 1888, by Samuel Parker; male adult, skin and skull, no. 186464, U. S. Natl. Mus. (no.  $\frac{4996}{57\frac{1}{2}}$ , Merriam collection) (orig. no. 143).

*Range*.—Interior Oregon and eastern California north to the Columbia River; east to the foothills of the Blue Mountains; south (in the Sierra Nevada) to Tulare County, Calif.; west to and including the Cascades in Oregon, and Mount Shasta, Calif. (fig. 20). *Zonal range*: Transition, Canadian, and Hudsonian.

*External characters*.—Compared with *C. saturatus* and *C. l. lateralis*: Head darker; mantle more extensive and brighter colored; black dorsal stripes broader and more extensive, the inner pair equal in width to outer pair; under side of tail darker (more tawny). Compared with *C. l. castaneus*: Mantle lighter (more yellowish); light dorsal stripes clearer white; under side of tail paler; external measurements averaging smaller.

*Cranial characters*.—Skull similar to that of *lateralis*, but smaller, with relatively shorter rostrum and nasals; postorbital constriction relatively greater. Compared with *saturatus*: Much smaller, but postorbital constriction relatively greater.

*Color*.—*Summer pelage*: Top of head mikado brown; sides of head and neck, ears, and shoulders bright ochraceous tawny; sides of nose and lower cheeks warm buff; median dorsal area vinaceous buff or tilleul buff, shading to fawn color or army brown on the rump; light dorsal stripes creamy white or sometimes ochraceous buff; inner pair of black stripes equal in length and breadth to outer pair; lower sides and feet pinkish buff; tail above, black, sprinkled with pinkish buff or ochraceous buff; tail beneath, tawny or ochraceous tawny bordered with black and edged with pinkish buff or ochraceous buff; under parts pinkish buff or buffy white. *Winter pelage* (October–April): General tone of upper parts more grayish; mantle poorly defined; head fawn color or mikado brown; sides of head and neck cinnamon buff; median dorsal area light drab, shading to fawn color on the rump; under side of tail clay color; feet buffy white.

*Molt*.—An adult male from Beech Creek, Oreg., July 2, had nearly completed the molt, new pelage covering most of the body except the hinder back and hind legs, which are in old, worn pelage. An adult female from Diamond Lake, Oreg., August 12, and another from Mount Shasta, Calif., August 21, had just begun to acquire new pelage on the head and the middle of the back.

*Measurements.*—Average of 10 adult males from Fort Klamath and Crater Lake, Oreg.: Total length, 259 (242–275); tail vertebrae, 89.6 (83–94); hind foot, 39.7 (39–41); ear from notch (dry), 15.2 (14–16). Average of 10 adult females from same localities: 253.5 (235–278); 88.1 (82–102); 39.1 (37–41); 15.2 (14–16.5). *Skull.* Average of 10 adult males from same localities: Greatest length, 42.3 (41–44); palatilar length, 19.5 (18.5–21); zygomatic breadth, 26.3 (24.8–28); cranial breadth, 19.5 (19.1–20); interorbital breadth, 10.2 (9.3–11.2); postorbital constriction, 13.2 (12.5–13.9); length of nasals, 14.4 (13.3–15.8); maxillary tooth row, 8.2 (7.6–8.6). Average of 10 adult females from same localities: Greatest length, 41.1 (39.6–42.7); palatilar length, 18.7 (18–19.5); zygomatic breadth, 25.5 (23.8–26.4); cranial breadth, 19.3 (18.1–19.9); interorbital breadth, 9.5 (9.1–10); postorbital constriction, 12.7 (11.2–14); length of nasals, 14.4 (13.2–15.4); maxillary tooth row, 8 (7.4–8.7).

*Weight.*—Average of 10 males, 181 g (155–218); of 10 females, 199 g (136–245) (Grinnell and Dixon, 1918, p. 676).

*Remarks.*—Over its very wide range, this subspecies intergrades with several other races. Specimens from Four Mile Lake, Oreg., a short distance southwest of Fort Klamath, have darker and more extensive mantles than typical specimens; in Siskiyou and Trinity Counties, Calif., intergradation with the subspecies *C. l. mitratus* takes place, the large series from there being referred to the latter form. At the southern end of the Sierra Nevada (Sequoia National Park, Mount Whitney, etc.) the animals differ from typical *chrysodeirus* in having slightly darker mantles, thus approaching *C. l. bernardinus* in color; their skulls are also closely similar to those of *bernardinus*, being longer and relatively narrower than typical *chrysodeirus*; the tails, however, are fully as long as in *chrysodeirus*. Some individuals from Mount Whitney, Bishop Creek, and head of San Joaquin River have whitish feet and bellies, thus showing approach to *C. l. trepidus*. Several specimens from East Fork of Kaweah River have very dark tails, darker even than those of *C. l. certus*.

*Specimens examined.*—Total number, 543, as follows:

**California:** Alta Peak (Kaweah River, Sequoia National Park), 4; Aspen Meadow (Tuolumne County), 7; Bald Mountain (8 miles west, Shasta County), 1; Bartle (McCloud River), 5; Bieber (Lassen County), 1; Big Valley Mountains, 11; Bishop Creek (9,000–10,000 feet altitude, Inyo County), 4; Bear Creek Valley (west of Dana, Shasta County), 1; Beswick (Siskiyou County), 1; Bullfrog Lake (Fresno County), 6;<sup>39</sup> Buck's Ranch (Plumas County), 1; Bunch Grass Spring (Madeline Plains), 2; Carberry Ranch (12 miles west of Burney, Shasta County), 6; Chaparral, 3;<sup>43</sup> Cisco (Placer County), 1; Cottonwood Lakes (Inyo County), 1;<sup>39</sup> Crown Valley (Middle Fork, Kings River, Fresno County), 1;<sup>40</sup> Cutts Meadow (near Huntington Lake, Fresno County), 2;<sup>40</sup> Dinkey Creek (North Fork, Kings River, Fresno County), 1; Donner, 20; Eagle Lake, 1; Eureka Mill (Shasta County), 1; Evolution Lake (head South Fork, San Joaquin River), 1;<sup>40</sup> Foster Ridge (near Huntington Lake, Fresno County), 1;<sup>40</sup> Goose Lake, 2; Goose Nest Mountain (Siskiyou County), 6; Greenville (8 miles northwest), 13; Hayden Hill (Lassen County), 3; Horse Corral Meadows (north of Mount Silliman, Fresno County), 4; Hope Valley (Alpine County), 1; Huntington Lake (Fresno County), 1;<sup>41</sup> Ice Caves (6 miles southwest of Tule Lake), 2; Kaweah River (East Fork, Sequoia National Park), 7; Kearsarge Pass (Fresno County), 5;<sup>39</sup> Lassen County, 6; Lassen Creek (east side of Goose Lake), 7; Lassen Peak, 15; Letter Box (Plumas County), 2; Little Onion Valley, 1;<sup>39</sup> Little Pete Meadow (Kings River, Fresno County), 1;<sup>40</sup> Long Valley (Mono County), 1;<sup>39</sup> Madeline Divide, 1; Madeline Plains, 1; Marie Lake (Selden Pass, Fresno County), 1;<sup>40</sup> Markleeville (Alpine County), 2;

<sup>39</sup> Mus. Vert. Zool.

<sup>40</sup> Cleveland Mus. Nat. Hist.

<sup>41</sup> Wm. T. Shaw collection.

<sup>43</sup> Field Mus. Nat. Hist.

McCloud (Siskiyou County), 2; McClure Meadow (head South Fork, San Joaquin River), 1; <sup>40</sup> McKinneys (Lake Tahoe), 2; Merced River (near head), 1; Merced River (Fish Camp, on South Fork), 1; Mohawk (Plumas County), 1; Mono Lake, 5; <sup>39</sup> Mono Pass, 1; Mount Dana, 1; Mount Shasta, 55; Mount Tallac, 5; Mount Unicorn, 1; Mount Whitney, 27; Mulkey Meadows (15 miles south of Mount Whitney), 5; Onion Valley (Inyo County), 4; <sup>39</sup> Owens River (head), 2; Petes Valley (Lassen County), 1; Picard (Siskiyou County), 1; Quincy, 1; San Joaquin River (near head), 1; Sequoia National Park, 4; Shingletown (Shasta County), 1; Sierra Valley (Plumas County), 1; Sisson (Siskiyou County), 1; Summit Meadow (Tulare County), 1; Susan River (Lassen County), 1; Susanville (12 miles west), 2; Tahoe (Placer County), 1; Tenaya Lake, 1; Tuolumne Meadows, 3; Whitney Meadows (10 miles south of Mount Whitney), 1.

Nevada: Glenbrook (Lake Tahoe), 6; Lake Tahoe, 2.

Oregon: Antelope (Wasco County), 2; Arnold Ice Cave (Deschutes County), 1; Austin (Grant County), 1; Becch Creek (Grant County), 1; Bend, 7; Chiloquin (Klamath County), 1; Crater Lake, 28; Crooked River (20 miles southeast of Prineville), 1; Diamond Lake (Douglas County), 5; Drew Creek Valley (Lake County), 2; Fort Klamath, 74; Four-mile Lake (Klamath County), 12; Francisville (Wheeler County), 1; Fremont (Lake County), 4; Friend (Wasco County), 2; Gateway (Jefferson County), 2; Goose Lake Mountains, 1; Hay Creek (12 miles east, Jefferson County), 2; Heppner, 1; Howard (Crook County), 3; John Day River (Crown Rock), 3; Kamela (Union County), 1; Lone Rock (Gilliam County), 10; Maupin (Wasco County), 2; McKenzie Bridge, 1; Meacham (Umatilla County), 1; Mill Creek (20 miles west of Warm Springs), 6; Miller (mouth of Deschutes River), 6; Mount Hood, 7; Mount Mazama (Anna Creek, Crater Lake National Forest), 4; Naylox (Klamath Lake), 3; Ochoco National Forest (Crook County), 2; O'Leary Mountain (10 miles south of McKenzie Bridge), 1; Paulina Lake, 4; Rock Creek (Baker County), 1; Silver Lake (10 miles southwest), 2; Sisters (Deschutes County), 4; Strawberry Mountains, 10; Three Sisters, 5; Wapinitia (Wasco County), 9; Warm Springs River (mountains north), 1; Willows (Gilliam County), 1.

#### CITELLUS LATERALIS CONNECTENS (HOWELL)

##### BLUE MOUNTAINS MANTLED GROUND SQUIRREL

*Callospermophilus chrysodeirus connectens* Howell, Jour. Mammal. 12: 161, May 14, 1931.

*Type*.—Collected at Homestead, Oreg., June 1, 1916, by H. H. Sheldon; male adult, skin and skull, no. 212461, U. S. Natl. Mus. (Biological Survey collection) (orig. no. 535).

*Range*.—The Blue Mountains region of northeastern Oregon and southeastern Washington (fig. 20). *Zonal range*: Transition and Canadian.

*External characters*.—Similar in summer pelage to *C. l. chrysoideirus*, but head and mantle darker; shoulders and fore back more vinaceous (less ochraceous); under side of tail paler. Similar in color to *C. l. castanurus* but under side of tail paler; sides of face and neck paler (more ochraceous).

*Cranial characters*.—Skull closely similar to that of *chrysoideirus*, averaging slightly larger.

*Color*.—*Summer pelage* (June 1): Head, ears, shoulders, and sides of neck russet, shaded on sides of neck and around ears with ochraceous buff and ochraceous tawny, and bordered next the throat with cinnamon buff; nape and foreback, between shoulders, cacao brown; median dorsal area fawn color, shading to army brown on rump and thighs; sides of body and feet pinkish buff; light dorsal stripes

<sup>39</sup> Mus. Vert. Zool.

<sup>40</sup> Cleveland Mus. Nat. Hist.

creamy white, tinged with pinkish buff; tail above, black, bordered with cinnamon buff; tail beneath, cinnamon or tawny, edged with cinnamon buff, and with a subterminal band of black; under parts pale pinkish buff or buffy white. *Winter pelage* (May 8): Mantle not well defined; top of head pinkish cinnamon; median dorsal area cinnamon drab, shading to fawn color on rump and to army brown on thighs; light dorsal stripes clear white, reaching to the ears; sides of neck washed with cinnamon buff; sides of body pale pinkish buff.

*Molt*.—An adult female from Homestead, Oreg., June 9, and another from Paradise, Oreg., June 10, were acquiring fresh pelage on the head and shoulders, the pelage on the rest of the body being considerably worn and faded.

*Measurements*.—Average of 7 adult males from type region: Total length, 266 (257–280); tail vertebrae, 92 (80–98); hind foot, 41.7 (40–43); ear from notch (dry), 14.8 (14–16). Average of 9 adult females from type region: Total length, 266 (255–280); tail vertebrae, 91.5 (80–100); hind foot, 40.9 (40–43); ear from notch (dry), 14.1 (13.5–15). *Skull*: Average of 9 adult males from type region; Greatest length, 42.7 (41.5–44.6); palatilar length, 19.7 (19–20.5); zygomatic breadth, 26.5 (25.8–27.5); cranial breadth, 19.4 (18.5–20.3); interorbital breadth, 9.6 (9–10.4); postorbital constriction, 12.3 (11–12.8); length of nasals, 14.9 (14–15.6); maxillary tooth row, 8.2 (7.2–8.8). Average of 8 adult females from type region: Greatest length, 42.4 (41.6–43.1); palatilar length, 19.5 (19–20.5); zygomatic breadth, 26.1 (24.6–27); cranial breadth, 19.3 (18.8–19.9); interorbital breadth, 9.4 (8.9–9.7); postorbital constriction, 12.6 (11.6–13.4); length of nasals, 14.5 (13.9–15.3); maxillary tooth row, 8.5 (7.9–8.9).

*Remarks*.—This subspecies is most nearly related to *chrysodeirus*, with which it intergrades in the foothill region of the Blue Mountains. It is very distinct from *C. l. tescorum* of central Idaho, and their ranges apparently do not meet.

*Specimens examined*.—Total number, 40, as follows:

Oregon: Anthony (Baker County), 1; <sup>44</sup> Cornucopia (Baker County), 6; <sup>45</sup> Homestead (Baker County), 7; Joseph, 1; <sup>47</sup> Paradise (15 miles northeast, Wallowa County), 1; Troy (Wallowa County), 4; Wallowa, 1; Wallowa Canyon, 2; Wallowa Lake, 3.  
Washington: Anatone (Asotin County), 2; Dayton, 2; <sup>45</sup> Godman Springs (Columbia County), 6; <sup>45</sup> Grand Ronde River (6 miles south of Anatone), 2; Humpeg Falls (Columbia County), 2. <sup>45</sup> <sup>46</sup>

#### CITELLUS LATERALIS TREPIDUS (TAYLOR)

##### NEVADA MANTLED GROUND SQUIRREL

*Callospermophilus trepidus* Taylor, Calif. Univ. Pubs., Zool. 5: 283, Feb. 12, 1910.  
*Citellus trepidus* Elliot, Check-list Mamm. North Amer. Sup., p. 29, 1917.  
*Callospermophilus chrysodeirus perpallidus* Grinnell, Calif. Univ. Pubs., Zool. 17: 429, 1918 (White Mountains, Calif.).

*Type*.—Collected at head of Big Creek, Pine Forest Mountains, Humboldt County, Nev. (8,000 feet altitude), June 27, 1909, by W. P. Taylor and C. H. Richardson, Jr.; male adult, skin and skull, no. 8240, Mus. Vert. Zool. (orig. no. 768).

*Range*.—Southeastern Oregon, southern Idaho, northern and central Nevada, and northwestern Utah; north in the Snake River Valley to southern Baker County, Oreg. (Home P. O.); west to Mount Warner, Oreg., and the Granite Range, Nev.; south to the Toyabe Mountains, Nev. and the White and Inyo Mountains, Calif.; east to Bannock County, Idaho (Swan Lake) and the Snake Range, eastern

<sup>44</sup> S. G. Jewett collection, Portland, Oreg.

<sup>45</sup> Univ. Michigan Mus. Zool.

<sup>46</sup> Mus. Vert. Zool.

<sup>47</sup> Carnegie Mus.

Nevada (fig. 20). *Zonal range*: Upper Sonoran, Transition, and Canadian.

*External characters*.—Similar to *C. l. chrysodeirus*, but tail longer and coloration paler; upper parts more grayish (less brownish), especially on the rump; under parts and feet more whitish (less buffy). Compared with *C. l. castanurus*: Upper parts paler (less brownish); mantle paler (more ochraceous); tail paler beneath.

*Cranial characters*.—Skull closely similar to that of *chrysodeirus*; interpterygoid fossa and nasals averaging slightly narrower.

*Color*.—*Summer pelage* (June–July): Top of head hazel; sides of head and face, and shoulders, ochraceous tawny, shaded with cinnamon buff; ears cinnamon buff; median dorsal area vinaceous fawn, more or less shaded with grayish white, becoming fawn color or army brown on the rump and thighs; light dorsal stripes creamy white or pinkish buff; both pairs of black stripes of equal width, reaching from shoulders to hips; lower sides pinkish buff or pale pinkish buff; hind feet creamy white or pale pinkish buff; front feet pinkish buff; tail above, black, mixed with warm buff and bordered with the same; tail beneath, tawny or cinnamon, bordered with black and edged with warm buff; under parts creamy white, faintly shaded with pale pinkish buff. *Winter pelage* (Ruby Mountains, Nev., June 20): Median dorsal area nearly uniform pale smoke gray, shaded with vinaceous cinnamon on nose and head; mantle nearly obsolete, the shoulders and sides of neck washed with cinnamon buff.

*Molt*.—In two females from White Pine County, Nev., June 18 and 23, new summer pelage is coming in on the top of the head.

*Measurements*.—Average of 10 adults (4 males, 6 females) from type locality: Total length, 268.6 (252–288); tail vertebrae, 101.2 (90–108); hind foot, 40.5 (39–44); ear from notch (dry), 13.9 (13–16). *Skull*: Average of 7 adults (2 males, 5 females) from type locality: Greatest length, 42.8 (41.8–44); palatilar length, 19.8 (19–20.2); zygomatic breadth, 26.9 (25.6–27.7); cranial breadth, 19.8 (19.3–20.8); interorbital breadth, 9.5 (9.1–9.8); postorbital constriction, 12.2 (11.4–14); length of nasals, 14.9 (14.4–15.4); maxillary tooth row, 8.4 (8.1–9.3).

*Weight*.—Average of 10 males from White Mountains, Calif., 182 g (166.5–199.5); of 10 females, 160 g (141–209.1) (Grinnell and Dixon, 1918, p. 682).

*Remarks*.—This race is only slightly different from typical *chrysodeirus*, being chiefly distinguished by its more whitish feet and under parts. Occasional specimens from within the range of *trepidus* are difficult to distinguish from *chrysodeirus*.

A large series of "*perpallidus*" (topotypes) proves on comparison to be practically identical with *trepidus*.

*Specimens examined*.—Total number, 260, as follows:

- California**: Glass Mountain (Mono Hills, Mono County), 3;<sup>48</sup> Inyo Mountains, 12; Mammoth (Mono County), 1;<sup>49</sup> Mammoth Lakes, 1;<sup>40</sup> Sherwin Hill, Round Valley (Mono County), 4;<sup>48</sup> White Mountains, 62.<sup>50</sup>
- Idaho**: Albion (Cassia County), 3; Bannock Mountains (8 miles west of Swan Lake), 1; Silver City, 10.
- Nevada**: Arc Dome (Toyabe Mountains), 3; Badger (20 miles northwest of Summit Lake, Humboldt County), 2; Baker Creek (White Pine County), 9;<sup>51</sup> Bull Run Mountains, 1; Carlin, 1;<sup>40</sup> Cottonwood Range, 3; Edgewood (Douglas County), 1;<sup>52</sup> Granite Creek, 5; Lehman Creek (White Pine

<sup>48</sup> Cleveland Mus. Nat. Hist.

<sup>49</sup> Univ. Michigan Mus. Zool.

<sup>50</sup> Forty in Mus. Vert. Zool.; six in Cleveland Mus. Nat. Hist.

<sup>51</sup> Mus. Vert. Zool.

<sup>52</sup> Amer. Mus. Nat. Hist.

County), 1; <sup>51</sup> Little Owyhee River, 9; Monitor Mountains (25 miles southwest of Eureka), 6; Mount Siegel (Douglas County), 4; <sup>52</sup> Palisade, 1; Pine Forest Mountains, 37; <sup>51</sup> Reese River (head), 3; Ruby Mountains, 5; Ruby Valley, 1; Stella Lake, Snake Mountains (White Pine County), 11; <sup>51</sup> Toyabe Mountains, 4; Virgin Valley, 1; <sup>51</sup> Willard Creek (White Pine County), 5 <sup>51</sup>.

**Oregon:** Barren Valley (Steens Mountain region), 1; Beulah, 1; Buchanan (Harney County), 7; Burns, 2; Cedar Mountains, 3; Cow Creek Lake, 1; Disaster Peak (Malheur County), 1; Drewsey (Harney County), 3; Harney (Harney County), 2; Home (Baker County), 2; Huntington, 5; McDermitt Creek (8 miles northeast of McDermitt, Nev.), 3; Mount Warner (= Hart Mountain, Lake County), 1; Riverside (Malheur County), 7; Shirk (6 miles southeast of Blitzen, Harney County), 2; Steens Mountains, 2; Westfall (Malheur County), 5.

**Utah:** Raft River Mountains (17 miles northwest of Kelton), 2. <sup>51</sup>

### CITELLUS LATERALIS CERTUS (GOLDMAN)

#### CHARLESTON MOUNTAINS MANTLED GROUND SQUIRREL

*Callospermophilus lateralis certus* Goldman, Jour. Mammal. 2: 232, Nov. 29, 1921.

*Type*.—Collected at north base of Charleston Peak, Charleston Mountains, Nev., June 29, 1915, by L. J. Goldman; male adult, skin and skull, no. 208891, U. S. Natl. Mus. (Biological Survey collection) (orig. no. 2270).

*Range*.—Charleston Mountains, Nev. (fig. 20). *Zonal range*: Transition.

*External characters*.—Similar to *C. l. trepidus*, but tail shorter and darker beneath; coloration paler and more grayish (less brownish); black dorsal stripes shorter, the inner pair narrower. Compared with *C. l. chrysoleirus*: Coloration much paler and more grayish; under parts and feet white instead of buff; tail shorter and darker.

*Cranial characters*.—Skull similar to that of *trepidus*, but averaging slightly narrower across the zygomata; nasals shorter, and narrower posteriorly.

*Color*.—*Summer pelage*: Head, nape, and shoulders mikado brown, bordered next the throat with warm buff; throat warm buff in some specimens; middle of back and rump smoke gray, mixed with cinnamon drab; light dorsal stripes white, narrowing posteriorly; dark dorsal stripes reduced, the outer pair scarcely reaching the hips, the inner pair narrower and still shorter; hind legs washed with mikado brown; hind feet creamy white or pale pinkish buff; front feet pinkish buff or pale pinkish buff; tail above, black, edged with ochraceous buff; tail beneath, russet or tawny, bordered with black and edged with ochraceous buff; under parts creamy white. *Winter pelage*: Not seen, but a specimen in changing pelage (June 29) indicates that the head is drab gray and the mantle mostly obsolete.

*Molt*.—Specimens taken at the type locality, June 29 and 30 and July 2 are in process of molting; on some, the heads still retain some of the old winter pelage, the new hair coming in in patches; a male taken July 6 has the entire mantle in summer pelage, the rest of the body in winter pelage.

*Measurements*.—Average of 18 adults (7 males, 11 females) from type locality: Total length, 249 (230–258); tail vertebrae, 77.4 (70–90); hind foot, 38.5 (35–41); ear from notch (dry), 15.1 (14–16.5). *Skull*: Average of 6 males (adult and subadult) from type locality: Greatest length, 42.5 (41–43.4); palatilar length, 19.9 (19–20.5); zygomatic breadth, 26 (25–27.2); cranial breadth, 19.9 (19.3–20.3); interorbital breadth, 9.8 (9.2–10.4); postorbital con-

<sup>51</sup> Mus. Vert. Zool.

<sup>52</sup> Amer. Mus. Nat. Hist.

striction, 13.2 (12.8-13.8); length of nasals, 13.8 (13.3-14.2); maxillary tooth row, 8.1 (7.8-8.6). Average of 7 adult females; Greatest length, 41.7 (41-42.8); palatilar length, 19 (18-20); zygomatic breadth, 25.2 (24.4-25.7); cranial breadth, 19.5 (19-20); interorbital breadth, 9.4 (8.9-9.6), postorbital constriction, 12.9 (12.2-13.5); length of nasals, 13.7 (12.8-14.4); maxillary tooth row, 8.3 (7.7-8.7).

*Remarks.*—Isolated on the Charleston Mountains, this short-tailed pale race is nearest to *trepidus* of the region to the northward; although in general coloration it is among the palest of the races, its tail is as dark as in any of the subspecies.

*Specimens examined.*—Total number, 21,<sup>53</sup> from type locality.

#### CITELLUS LATERALIS BERNARDINUS (MERRIAM)

##### SAN BERNARDINO MANTLED GROUND SQUIRREL

*Spermophilus chrysodeirus brevicaudus* Merriam, Biol. Soc. Wash. Proc. 8: 134, 1893 (not *Spermophilus brevicauda* Brandt, 1884).

*Spermophilus (Callospermophilus) bernardinus* Merriam, Science (n. s.) 8: 782, Dec. 2, 1893 (substitute for *brevicaudus*).

*Callospermophilus bernardinus* Mearns, U. S. Natl. Mus. Bull. 56: 313, 1907.

*Citellus chrysodeirus bernardinus* Elliot, Field Columb. Mus. Pub., Zool. Ser. 6: 107, 1905.

*Type.*—Collected on San Bernardino Peak, Calif., October 9, 1893, by J. E. McLellan; female subadult, skin and skull, no. 56661, U. S. Natl. Mus. (Biological Survey collection) (orig. no. 274).

*Range.*—San Bernardino Mountains (6,700-11,485 feet, *vide* Grinnell) (fig. 20). *Zonal range:* Canadian and Hudsonian.

*External characters.*—Closely similar in summer pelage to *C. l. chrysodeirus*, but mantle averaging slightly darker, especially on the nape; in winter pelage upper parts more grayish (less vinaceous); under parts slightly paler (less buffy); tail shorter; hind foot longer.

*Cranial characters.*—Skull similar to that of *chrysodeirus*, but averaging slightly larger, with longer nasals.

*Color.*—*Summer pelage:* Top of head and face pecan brown or mikado brown, this color reaching on to the back between the shoulders; sides of head and neck ochraceous tawny; median dorsal area fawn color or smoke gray; chin and throat pale pinkish buff; belly creamy white; tail beneath, tawny. *Winter pelage (June):* General tone grayish (decidedly different from the summer pelage); mantle only faintly indicated and much paler; top of head and face cinnamon; sides of head, neck, and shoulders ochraceous buff; dorsal area smoke gray, shaded with cinnamon drab; sides grayish white; feet grayish white, faintly washed with pale pinkish buff; tail as in summer.

*Molt.*—A male taken June 19 shows fresh summer pelage covering the head and neck, the rest of the body being in worn winter pelage; a female taken June 28 shows new pelage covering the nose and face, reaching to the ears.

*Measurements.*—Average of 7 adult males from San Bernardino Mountains: Total length, 255 (246-265); tail vertebrae, 77.3 (70-84); hind foot, 42 (40-45); ear from notch (dry), 15.4 (15-16). Average of 10 adult females: Total length, 249.5 (239-272); tail vertebrae, 71.1 (63-80); hind foot, 40.2 (38-42); ear from notch, 15.6 (14-16.5). *Skull:* Average of 9 adult males: Greatest length, 42.8 (41.8-43.7); palatilar length, 19.5 (19-20); zygomatic breadth, 26.6 (26-27.8); cranial breadth, 19.2 (18.7-19.5); interorbital breadth, 10.7 (10.1-

<sup>53</sup> Seventeen in D. R. Dickey collection.

11.6); postorbital constriction, 12.9 (12.5–13.7); length of nasals, 15.7 (14.8–16.7); maxillary tooth row, 8.3 (7.9–8.8). Average of 10 adult females: Greatest length, 42 (40.4–44); palatilar length, 19.1 (18.5–20); zygomatic breadth, 25.8 (24.9–26.8); cranial breadth, 19 (18.6–19.7); interorbital breadth, 10.2 (9.4–10.8); postorbital constriction, 12.8 (11.9–13.7); length of nasals, 15.4 (14.1–16.3); maxillary tooth row, 8.1 (7.5–8.5).

*Remarks.*—Although geographically isolated from *chrysodeirus*, this race is so close to the latter in characters that a subspecific designation seems best to express its relationship. As pointed out under *chrysodeirus*, specimens of that race from the southern Sierra Nevada approach *bernardinus* in certain characters.

*Specimens examined.*—Total number, 49, as follows:

**California:** Big Bear Lake (San Bernardino County), 1; San Bernardino Mountains, 48.

#### CITELLUS LATERALIS MITRATUS (HOWELL)

YOLLA BOLLY MANTLED GROUND SQUIRREL

(Pls., 27, A; 32, A)

*Callospermophilus chrysodeirus mitratus* Howell, Jour. Mammal. 12: 161, May 14, 1931.

*Type.*—Collected on South Yolla Bolly Mountain, Calif., July 30, 1905, by J. F. Ferry; male adult, skin and skull, no. 138125, U. S. Natl. Mus. (Biological Survey collection) (orig. no. 13).

*Range.*—Coast ranges of northern California, from Glenn County north to southern Siskiyou County (fig. 20). *Zonal range:* Canadian and Transition.

*External characters.*—Similar to *C. l. chrysodeirus*, but upper parts paler and more grayish (less brownish); especially on the rump; mantle darker, especially on sides of head and on shoulders; tail averaging longer and darker beneath; hind feet longer. Compared with *C. l. trinitatis*: Upper parts much paler; mantle deeper colored and more extensive; external measurements smaller.

*Cranial characters.*—Skull larger than that of *chrysodeirus*, with longer nasals. Compared with *trinitatis*: Skull about same length, but zygomata more widely expanded posteriorly and nasals longer.

*Color.*—*Summer pelage:* Head and mantle russet, this color extending on to the shoulders and fore back, shaded on sides with ochraceous tawny; throat and sides of nose warm buff; ears russet, shaded with ochraceous tawny; eye ring buffy white; median dorsal area smoke gray, shading in some specimens to army brown on rump and thighs; light dorsal stripes creamy white; sides of body pinkish buff; feet cinnamon buff; tail above, black or fuscous black, mixed with warm buff; tail beneath, tawny, bordered with fuscous black and edged with warm buff; under parts pinkish buff, shading to warm buff. *Winter pelage* (September 26): Head sayal brown or mikado brown; mantle nearly obsolete; sides of neck clay color, washed with dull tawny; otherwise as in summer.

*Molt.*—Two adult females from Canyon Creek, Calif., taken August 21, show new pelage coming in on the head and the middle of the back.

*Measurements.*—Average of 10 adults (5 males, 5 females) from type locality (including 2 from Grindstone Creek, northern Glenn County): Total length, 269 (254–283); tail vertebrae, 94.1 (81–110); hind foot, 41.4 (40–43); ear from notch, 14.5 (13–16). *Skull:* Average of 8 adults (5 males, 3 females) from

same localities: Greatest length, 43.5 (42-44.4); palatilar length, 20.3 (19.8-20.5); zygomatic breadth, 27.5 (26.8-28.4); cranial breadth, 19.9 (19.3-20.8); interorbital breadth, 10.1 (10-10.9); postorbital constriction, 12.7 (12.4-13.2); length of nasals, 15.7 (15.3-16.6); maxillary tooth row, 8.1 (7.6-8.7).

*Remarks.*—This race is most strongly developed in the vicinity of South Yolla Bolly Mountain. The specimens from northern Trinity and southern Siskiyou Counties agree in size with typical *mitratus* but are slightly darker; the skulls average a little longer, and narrower across the zygomata, thus showing approach to *trinitatis*. Specimens from Bear Creek in the northeastern corner of Trinity County show approach to *chrysodeirus* in small average size of the skulls.

*Specimens examined.*—Total number, 83, as follows:

**California:** Bear Creek (head, Trinity County), 11;<sup>54</sup> Canyon Creek (Trinity County), 4; Castle Lake (Siskiyou County), 2;<sup>54</sup> Coast Range (17 miles west of Paskenta, Tehama County), 1; Coffee Creek (North Fork, Trinity County), 3;<sup>54</sup> Grindstone Creek (Tehama County), 2; Grizzly Creek (head, Trinity County), 5;<sup>54</sup> Jackson Lake (Siskiyou County), 5;<sup>54</sup> Kangaroo Creek (Siskiyou County), 1;<sup>54</sup> Rush Creek (head, Siskiyou County), 6;<sup>54</sup> Salmon Mountains (near Etna Mills), 11; Salmon River (South Fork, Siskiyou Mountains), 8;<sup>54</sup> Saloon Creek Divide (Siskiyou County), 11;<sup>54</sup> South Yolla Bolly Mountain, 10; Wildcat Peak (Siskiyou County), 3.<sup>54</sup>

#### CITELLUS LATERALIS TRINITATIS (MERRIAM)

##### TRINITY MOUNTAINS MANTLED GROUND SQUIRREL

*Callospermophilus chrysodeirus trinitatis* Merriam, Biol. Soc. Wash. Proc. 14: 126, July 19, 1901.

*Citellus chrysodeirus trinitatis* Elliot, Field Columb. Mus. Pub., Zool. Ser. 6: 107, 1905.

*Type.*—Collected at 5,700 feet altitude in the Trinity Mountains, east of Hoopa Valley, Calif., September 10, 1898, by Vernon Bailey; female adult, skin and skull, no. 95531, U. S. Natl. Mus. (Biological Survey collection) (orig. no. 6693).

*Range.*—Trinity Mountains in northern Humboldt County, north through the Siskiyou Mountains to southwestern Oregon (fig. 20).  
*Zonal range:* Canadian and Transition.

*External characters.*—Similar to *C. l. chrysodeirus* but darker and more brownish above, particularly on the rump; mantle averaging slightly darker; sides of head and neck darker; tail averaging darker beneath; external measurements greater.

*Cranial characters.*—Skull similar to that of *chrysodeirus* but averaging longer and relatively narrower, the zygomata less expanded posteriorly.

*Color.*—*Summer pelage* (September 10): Top of head russet, this color reaching over the crown and middle of the nape, and on sides of head from the eyes to the shoulders, bordered next the throat with cinnamon buff or clay color; shoulders more or less shaded with ochraceous tawny; ears russet to ochraceous tawny; light dorsal stripes ochraceous buff on the shoulders, creamy white for the rest of their length, reaching to the hips but not on to the rump; median dorsal area fawn color, shading to natal brown on rump and thighs; both pairs of black stripes equal in width and nearly equal in length to white stripes; lower sides and under parts pinkish buff or warm

<sup>54</sup> Mus. Vert. Zool.

buff; feet cinnamon buff; tail above, black mixed with ochraceous tawny; tail beneath, tawny or bay edged with black and ochraceous tawny.

*Measurements.*—Average of 6 adults (3 males, 3 females) from type locality: Total length, 281.3 (260–295); tail vertebrae, 99.7 (91–109); hind foot, 43.2 (41–44); ear from notch, 15.2 (14.5–16.5). *Skull*: Average of 9 adults (5 males, 4 females) from type locality and (3 females) from Siskiyou Mountains: Greatest length, 43.1 (41.2–44.8); palatilar length, 19.8 (19–21); zygomatic breadth, 25.8 (24.8–27.5); cranial breadth, 19.4 (19.1–19.9); interorbital breadth, 9.9 (8.8–11); postorbital constriction, 12.9 (12.2–14.4); length of nasals, 14.9 (14–15.8); maxillary tooth row, 8 (7.6–8.7).

*Remarks.*—This, the darkest race of the *chrysodeirus* group, occupies a rather limited range in the coast mountains of northwestern California, intergrading with *C. l. mitratus* to the eastward.

*Specimens examined.*—Total number, 30, as follows:

**California:** Preston Peak, 3; Siskiyou Mountains, 15; Trinity Mountains (east of Hoopa Valley), 10.

**Oregon:** Briggs Creek (13 miles southwest of Galice), 1; Siskiyou, 1.

### CITELLUS SATURATUS (RHODS)

#### CASCADE MANTLED GROUND SQUIRREL

*Tamias lateralis saturatus* Rhoads, Acad. Nat. Sci. Phila. Proc. 1895: 43, April 9. [*Spermophilus lateralis*] *saturatus* Elliot, Field Columb. Mus. Pub., Zool. Ser. 2: 83, 1901.

*Citellus lateralis saturatus* Elliot, Field Columb. Mus. Pub., Zool. Ser. 6: 106, 1905.

*Callospermophilus lateralis saturatus* Miller, U. S. Natl. Mus. Bull. 79: 316, 1912.

*Type.*—Collected at Lake Kichelos [=Keechelus], Kittitas County, Wash. (8,000 feet altitude), September 1893, by Allan Rupert; male adult, skin and skull, no. 8365, Acad. Nat. Sci. Phila. (no. 1365, Rhoads collection).

*Range.*—The Cascade Mountain region of western Washington and southern British Columbia; north to Tulameen, British Columbia; south to the Columbia River Valley, southern Washington; east to the Similkameen River, British Columbia (fig. 20). *Zonal range:* Canadian.

*External characters.*—Size largest of the subgenus; coloration very similar to that of *C. lateralis lateralis*, but slightly darker, especially on the head, rump, and thighs; mantle not well defined; under parts more buffy (less whitish); median pair of dark stripes obsolete or much reduced and outer pair reduced in length and obscurely defined.

*Cranial characters.*—Skull similar to that of *lateralis* but decidedly larger in all measurements except the nasals, which are practically the same length. Compared with *C. l. chrysodeirus* and *C. l. tesorum*: Size much larger with longer rostrum and nasals.

*Color.*—*Fresh summer pelage:* Top and sides of head russet or mikado brown, bordered next the throat with cinnamon buff; shoulders russet, shaded with ochraceous tawny; ears tawny, shading to pinkish buff on posterior margin; eye ring pinkish buff; median dorsal area fawn color or hair brown; hips and thighs army brown; light dorsal stripes dull buffy white; outer pair of dark stripes black or fuscous black, washed with tawny; inner pair absent or faintly indicated; sides warm buff; front feet cinnamon buff; hind feet pinkish buff; tail above, black, mixed with cinnamon buff; tail be-

neath, cinnamon or cinnamon buff, more or less mixed with black; under parts cinnamon buff.

*Molt*.—The annual molt takes place in June or July; four specimens from Trout Lake, Wash., June 27 and 28, show fresh pelage covering the head and shoulders, the remaining parts of the body being in a worn and faded pelage.

*Measurements*.—Average of 10 adult males from the Cascade Mountains, Wash.: Total length, 305 (287–315); tail vertebrae, 110.9 (100–118); hind foot, 46.5 (44–49); ear from notch (dry), 17 (16–18). Average of 10 adult females from same localities: Total length, 300 (286–312); tail vertebrae, 106.5 (92–116); hind foot, 45.4 (43–48); ear from notch (dry), 17.8 (17–18.5). *Skull*: Average of 10 adult males from the Cascades: Greatest length, 46.4 (44–48.3); palatilar length, 21.4 (20–22.5); zygomatic breadth, 28.9 (27.7–30.4); cranial breadth, 20.4 (19.5–20.9); interorbital breadth, 11.5 (10.9–12.3); postorbital constriction, 13.4 (12.9–14.2); length of nasals, 16.8 (15.8–17.7); maxillary tooth row, 8.9 (8.1–9.5); average of 10 adult females from same localities: Greatest length, 45.2 (43.9–46.3); palatilar length, 20.8 (20–21.3); zygomatic breadth, 28.1 (27.2–28.6); cranial breadth, 19.9 (19.5–20.2); interorbital breadth, 11 (10.6–11.6); postorbital constriction, 13.3 (12.4–14); length of nasals, 16 (15.6–16.6); maxillary tooth row, 9 (8.6–9.6).

*Remarks*.—The Cascade mantled ground squirrel differs so markedly from the other members of the subgenus that it seems necessary to regard it as a full species. It resembles *C. lateralis lateralis* of Colorado more nearly than any of the other races, but is widely separated from it geographically. It is very different from *chryso-deirus*, whose range it nearly meets but from which it is separated by the Columbia River. So far as known, there is a wide gap in British Columbia between the range of *saturatus* and that of *tescorum* and the two forms are very dissimilar in their characters.

*Specimens examined*.—Total number, 111, as follows:

**British Columbia:** Hedley, 5;<sup>55</sup> Hope-Princeton Summit, 3;<sup>55</sup> Keremeos (Ashnola Creek), 2;<sup>55</sup> Lightning Lakes (near Boundary Monument 77, Yale District), 1; Second Summit (west of Skagit River), 5;<sup>55</sup> Skagit River, 1;<sup>56</sup> Tulameen, 1;<sup>56</sup> Whipsaw Creek (branch of Similkameen River), 1.<sup>55</sup>  
**Washington:** Bald Mountain (Okanogan County), 1; Barron (Whatcom County), 5; Bauerman Ridge (Okanogan County), 1; Bumping Lake (Yakima County), 1; Cleveland (Klickitat County), 1; Easton, 18; Goldendale, 4; Hannegan Pass (Whatcom County), 1; Hart Lake (Chelan County), 1; Keechelus (Kittitas County), 3; Keechelus Lake, 1; Lake Chelan, 1; Mazama (Okanogan County), 1; Mount Adams, 2; Mount Aix, 1; Mount Rainier, 16; Mount St. Helens, 3; Rainier Fork Ridge, 4; Spray Park (Pierce County), 1;<sup>57</sup> Stehekin (head of Lake Chelan), 2; "Tannum River" (=Bumping River), 1; Trout Lake (Klickitat County), 13; Wenatchee, 3; Wenatchee Lake, 1; Whipsaw Creek (branch of Similkameen River), 1;<sup>55</sup> Yakima Indian Reservation (Signal Peak), 5.

#### CITELLUS MADRENSIS (MERRIAM)

##### SIERRA MADRE MANTLED GROUND SQUIRREL

(Pls. 27, B; 32, B)

*Callospermophilus madrensis* Merriam, Wash. Acad. Sci. Proc. 3: 563, Nov. 29, 1901.

[*Citellus*] *madrensis* Elliot, Field Columb. Mus. Pub., Zool. Ser. 4: 147, 1904.

*Type*.—Collected in the Sierra Madre, near Guadalupe y Calvo, Chihuahua, Mexico (7,000 feet altitude), August 27, 1898, by E. W.

<sup>55</sup> Natl. Mus. Canada.

<sup>56</sup> Provincial Mus., Victoria, British Columbia.

<sup>57</sup> Univ. Michigan Mus. Zool.

Nelson and E. A. Goldman; female adult, skin and skull, no. 95363, U. S. Natl. Mus. (Biological Survey collection) (orig. no. 12923).

*Range*.—Sierra Madre, Mexico, from northwestern Durango north to latitude 27°, west of Batopilas, Chihuahua; limits of range not known (fig. 20). *Zonal range*: Transition.

*External characters*.—Similar to *C. lateralis lateralis* and *C. l. arizonensis*, but smaller, with much shorter tail; colors much duller, with scarcely any trace of a mantle; black stripes short and poorly defined, tending to become obsolete; white stripes reaching nearly to the root of the tail.

*Cranial characters*.—Skull similar to that of *lateralis* but smaller and relatively narrower; zygomata more appressed; brain case narrower and more highly arched.

*Color*.—Worn summer pelage (August 26–September 3); Head and face hazel or sayal brown; eye ring buffy white; lower cheeks, sides of lips, and fore legs warm buff; sides of neck and shoulders rather faintly washed with cinnamon buff and ochraceous tawny; ears thinly clothed on outer surface with cinnamon hairs; general tone of upper parts cinnamon drab or fawn color, darkest and purest on rump and thighs; light dorsal stripes dull whitish or pinkish buff; dark stripes blackish, often very faintly indicated; sides of body cinnamon buff or buffy white; tail above, fuscous black, mixed with warm buff; tail beneath, warm buff, tipped with blackish; hind feet pinkish buff; under parts pinkish buff or buffy white.

*Measurements*.—Average of 10 adults (3 males, 7 females) from type locality: Total length, 227.8 (215–243); tail vertebrae, 58.8 (52–66); hind foot, 38.7 (37–40); ear from notch (dry), 16.4 (15–18). *Skull*: Average of 7 adults (2 males, 5 females): Greatest length, 42.3 (41.1–44.1); palatilar length, 20.1 (19.5–20.5); zygomatic breadth, 25.6 (24.8–26.5); cranial breadth, 18.9 (18.5–19.3); interorbital breadth, 10.2 (9.9–10.5); postorbital constriction, 12.3 (11.9–12.7); length of nasals, 15.8 (15.1–17); maxillary tooth row, 8.5 (8.3–8.7).

*Remarks*.—The Sierra Madre ground squirrel, although clearly derived from the *C. l. lateralis* stock, has become so strongly differentiated that it must be treated as a distinct species. The known range of *madrensis* is separated from that of *arizonensis* by a gap of about 500 miles, though further collecting in the Sierra Madre may somewhat extend the range of the present form northward.

E. W. Nelson, who discovered the species, writes of its habits at the type locality as follows:

Very abundant in the pine woods about the base of Mohinora and reaches the extreme summit of the mountains. We saw them all along our route from above Gnanacevi in Durango to Guadalupe y Calvo. Their range extends only a little below 7,000 feet and does not enter the piñon belt.

*Specimens examined*.—Total number, 21, from type locality.

#### FOSSIL SPECIES

Eight fossil forms in the genus *Citellus* have been described from North America. Of these, two are from Miocene formations, two from the Pliocene, and four from the Pleistocene.

The most primitive species at present known is *Citellus (Protospermophilus) quatalensis* Gazin (1930, p. 64), from Quatal Canyon, 8

miles east of Cuyama Valley, Calif. Of this Miocene form the describer says:

On the basis of available material, *Citellus* (*Protospermophilus*) *quatalensis* appears to resemble the Recent genus or subgenus *Otospermophilus* more nearly than it does any of the other sciurids. Moreover, the new form presents an association of primitive characters which suggests that the dentition possessed by the modern otospermophilids is more primitive than that exhibited by the typical citellids. This is also indicated by the development of the premolars, which in the case of typical *Citellus* appear to have taken on more completely the characters of the molar teeth. From this consideration it seems probable that species of *Citellus* may have been derived from an *Otospermophilus*-like ancestor, probably later than the stage represented by *C. (P.) quatalensis*, assuming this form to be in or near the line of descent of the ground squirrels.

*Citellus ridgwayi* Gazin (1932, p. 61), from the Skull Spring Miocene beds, Malheur County, Oreg., is about the size of *Citellus* (*Callospermophilus*) *chrysodeirus* and resembles that species perhaps as nearly as it does any living form. It shows conspicuous differences, however, and cannot with certainty be assigned to any of the modern subgenera. Compared with *Callospermophilus* the skull of *C. ridgwayi* is flatter on the superior surface and wider between the orbits. "The outer and anterior margin of the zygoma . . . continues forward on the side of the muzzle as a small ridge, following the contour of the incisor to the alveolus" (Gazin). The molars are low-crowned, as in *Callospermophilus*;  $p^4$ ,  $m^1$ , and  $m^2$  are broader than long, and differ from the teeth of *Callospermophilus* in having a much less prominent parastyle. On  $m^1$  and  $m^2$  the protoloph and metaloph are not parallel as in *Callospermophilus*, but converge toward the inner side as they join the protocone.  $M^3$  has a reduced parastyle, a prominent protoloph, and a slight ridge in the basin of the tooth running toward the metacone.

*Otospermophilus gidleyi* Merriam, Stock, and Moody (1925, p. 68), from the Rattlesnake Pliocene, John Day Valley, Oreg., is thus characterized by the describers:

It is clearly distinguished from the other sciurids by the combined characters of the relatively shorter anteroposterior extent of all the cheek teeth. . . . A character which seems to distinguish the fossil distinctly from the living species of the citellid group is the much greater relative depth and apparently shorter proportions of the lower jaw.

*Citellus bensoni* Gidley (1922, p. 122), from the San Pedro Valley, Ariz. (Pliocene), was described from the molars only; as stated by Gidley, these teeth seem most nearly like those of *Otospermophilus*; the upper molars are relatively narrow in the transverse diameter, and the posterior loph is "broken up into two distinct but slightly joined cuspsules, the inner one of which is a rounded cone entirely disconnected from the protocone."

*Citellus tuitus* Hay (1921, p. 627), from Val Verde Mine, Ariz. (Pleistocene), was compared by the describer with *C. franklinii*, but it seems to be nearer to *C. mexicanus*; the tooth rows converge posteriorly about as in that species; the molars are higher-crowned on the inner side;  $m^3$  is longer than broad (nearly quadrate in *mexicanus*). Except for the more hypsodont molars, this species might be referred to the subgenus *Ictidomys*.

*Citellus cochisei* Gidley (1922, p. 121), from the San Pedro Valley, Ariz. (Pleistocene), was based on a right maxillary with all the molars, and part of a lower jaw. Both this species and *C. tuitus*

seem to be more closely related to *C. mexicanus* than to any other living species; both differ from *mexicanus* in having somewhat stouter and broader molars. The present species may with little hesitation be referred to the subgenus *Ictidomys*. Compared with *tuitus*, it differs in having the protocone of the upper molars stouter and less hypsodont; the metaloph on  $m^1$  and  $m^2$  is separated from the protocone by a wide sulcus; on  $m^3$  the protocone is likewise separated from the protocone by a wide sulcus;  $m^1$  and  $m^2$  are somewhat heavier than in *tuitus* but  $m^3$  is relatively shorter.

*Citellus taylori* Hay (1921, p. 616), based on a lower jaw from Pleistocene deposits near San Diego, Tex., is described as follows:

The jaw and teeth seem to resemble most those of *Citellus townsendi* [= *washingtoni*]. . . . The molar teeth have the same short, broad form, and the jaw itself is hardly different. The anterior crest of each tooth is, however, not so high as in that species and not so abruptly steep on its hinder face. . . . The premolar as long as wide; the cusps of its anterior crest with a shallow notch between them.

*Citellus beecheyi captus* Kellogg (1912, p. 164) from Pleistocene deposits at Rancho La Brea, Calif., is characterized by the describer as follows:

In the skull the width between the premaxillae and the anterior width of palate are less than in *Citellus v. fisheri*. The bullae are relatively long and narrow. In the lower jaw, the tooth row is long and the teeth heavy in proportion to the size of the ramus; the coronoid process, angle, and condyle are small.

This form is considered by Dice (1925, p. 125) to be referable to *C. beecheyi fisheri*.

In addition to the above species, several of the modern species have been found in Pleistocene deposits, as follows:

*Citellus tridecemlineatus* has been recorded from the Conard Fissure, Newton County, Ark. (Brown, 1908, p. 194); *C. douglasii* and *C. (Callospermophilus) chrysodeirus* have been found in cave deposits in Shasta County, Calif. (Kellogg, L., 1912, p. 155).

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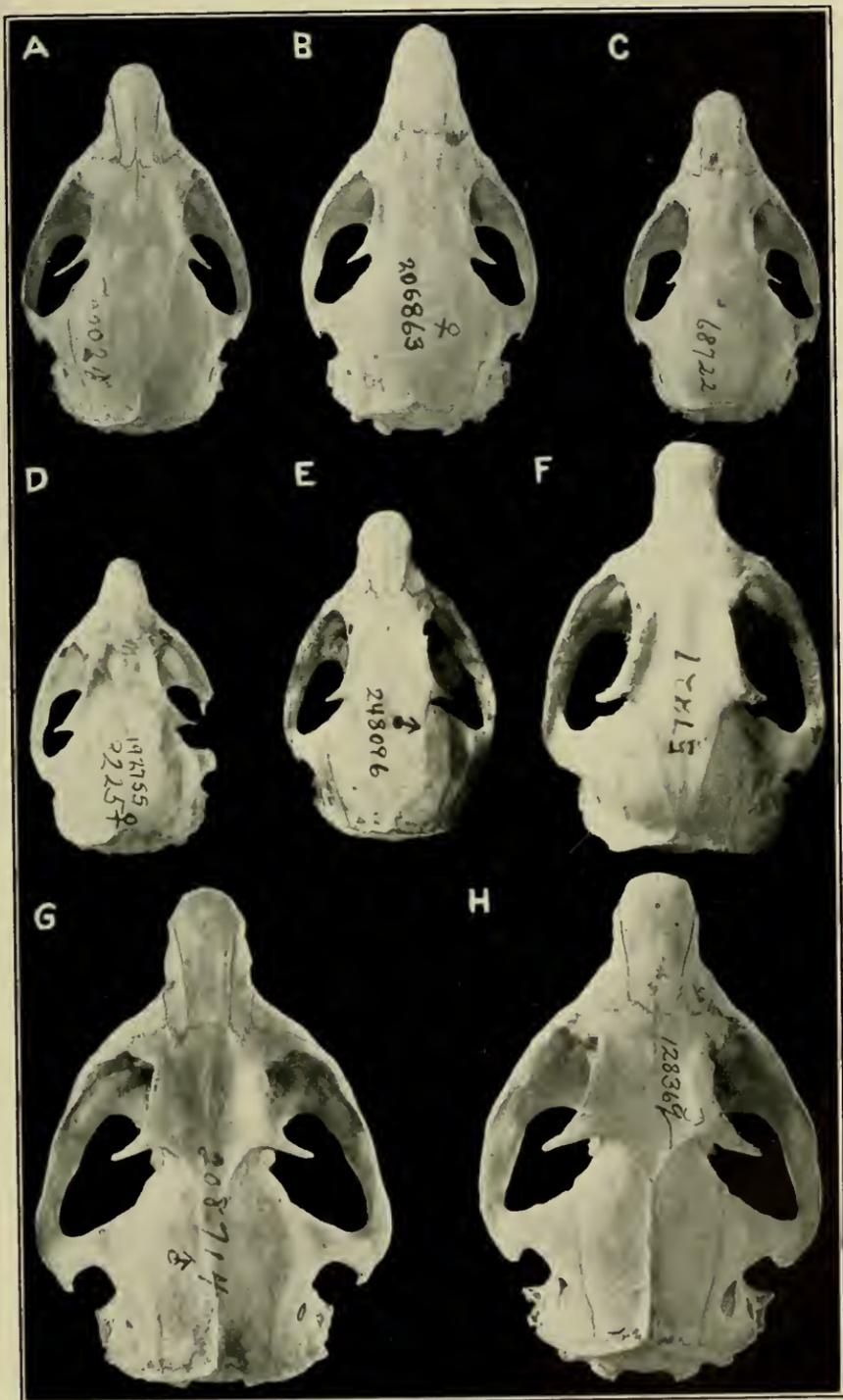
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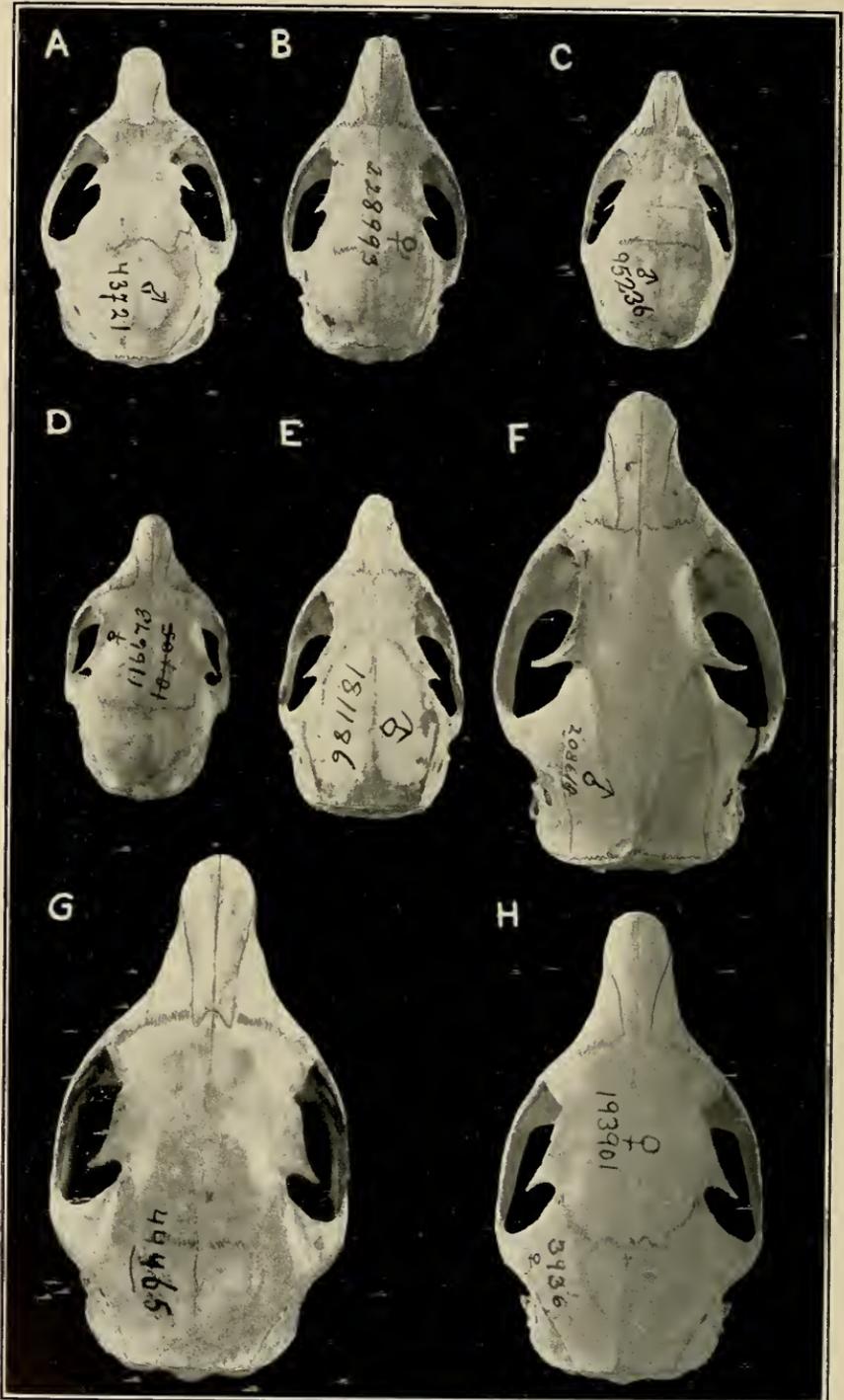
PLATE 14

(Natural size)

- A. *Citellus* (*Callospermophilus*) *saturatus*.
- B. *Citellus* (*Poliocitellus*) *franklinii*.
- C. *Citellus* (*Ictidomys*) *tridecemlineatus*.
- D. *Citellus* (*Xerospermophilus*) *mohavensis*.
- E. *Citellus* (*Citellus*) *citellus*.
- F. *Citellus* (*Citellus*) *fulvus*.
- G. *Cynomys* (*Cynomys*) *ludovicianus*.
- H. *Citellus* (*Citellus*) *parryii*.



SKULLS OF CITELLUS AND CYNOMYS.



SKULLS OF GLAUCOMYS, TAMIAS, EUTAMIAS, SCIURUS, MICROSCIURUS, AND CITELLUS.

PLATE 15

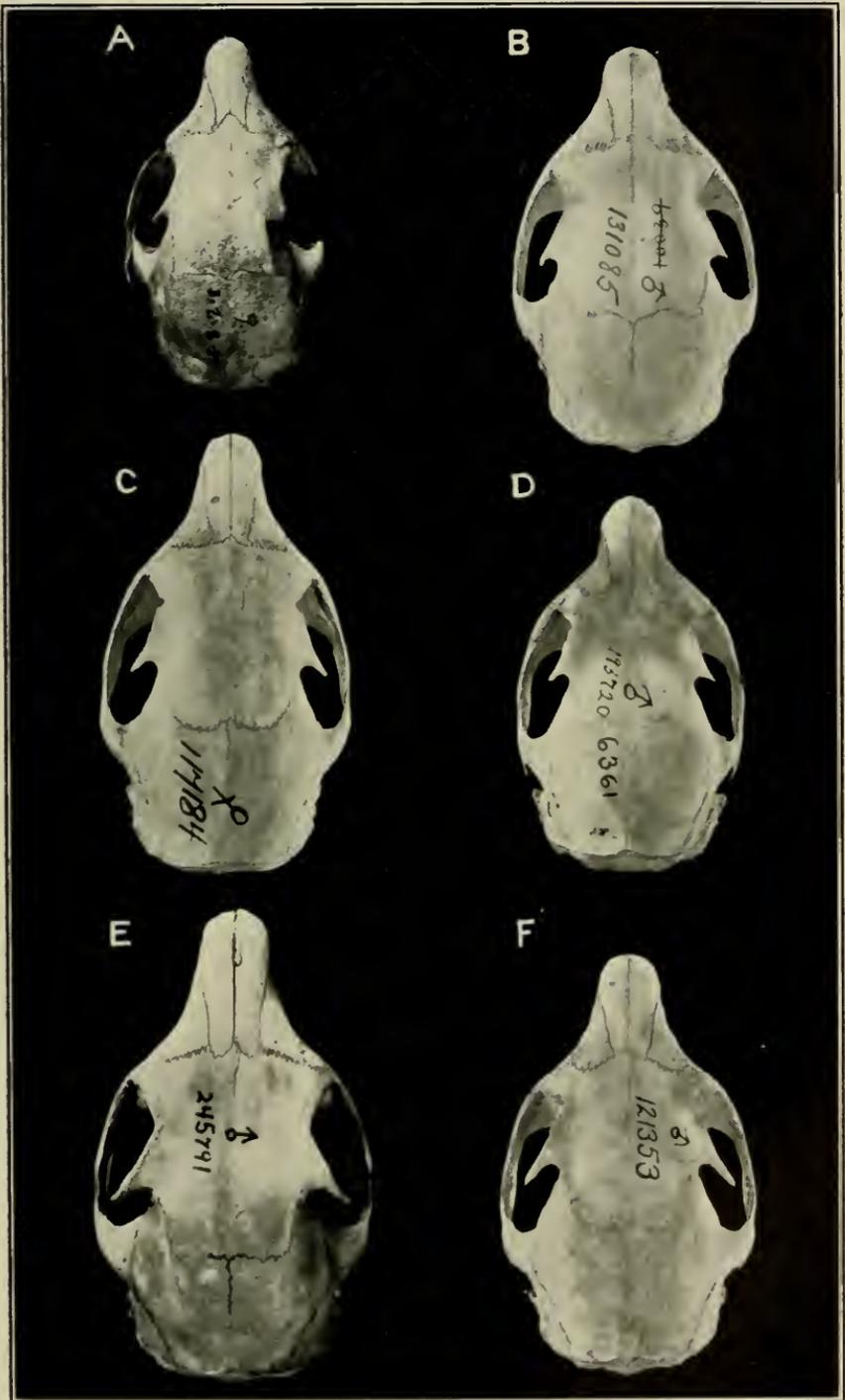
(Natural size)

- A. *Glaucomys volans volans*.
- B. *Tamias striatus*.
- C. *Eutamias (Neotamias) dorsalis*.
- D. *Microsciurus browni*.
- E. *Citellus (Ammospermophilus) harrisi*.
- F. *Citellus (Otospermophilus) variegatus grammurus*.
- G. *Sciurus (Hesperosciurus) griseus*.
- H. *Sciurus (Neosciurus) carolinensis*.

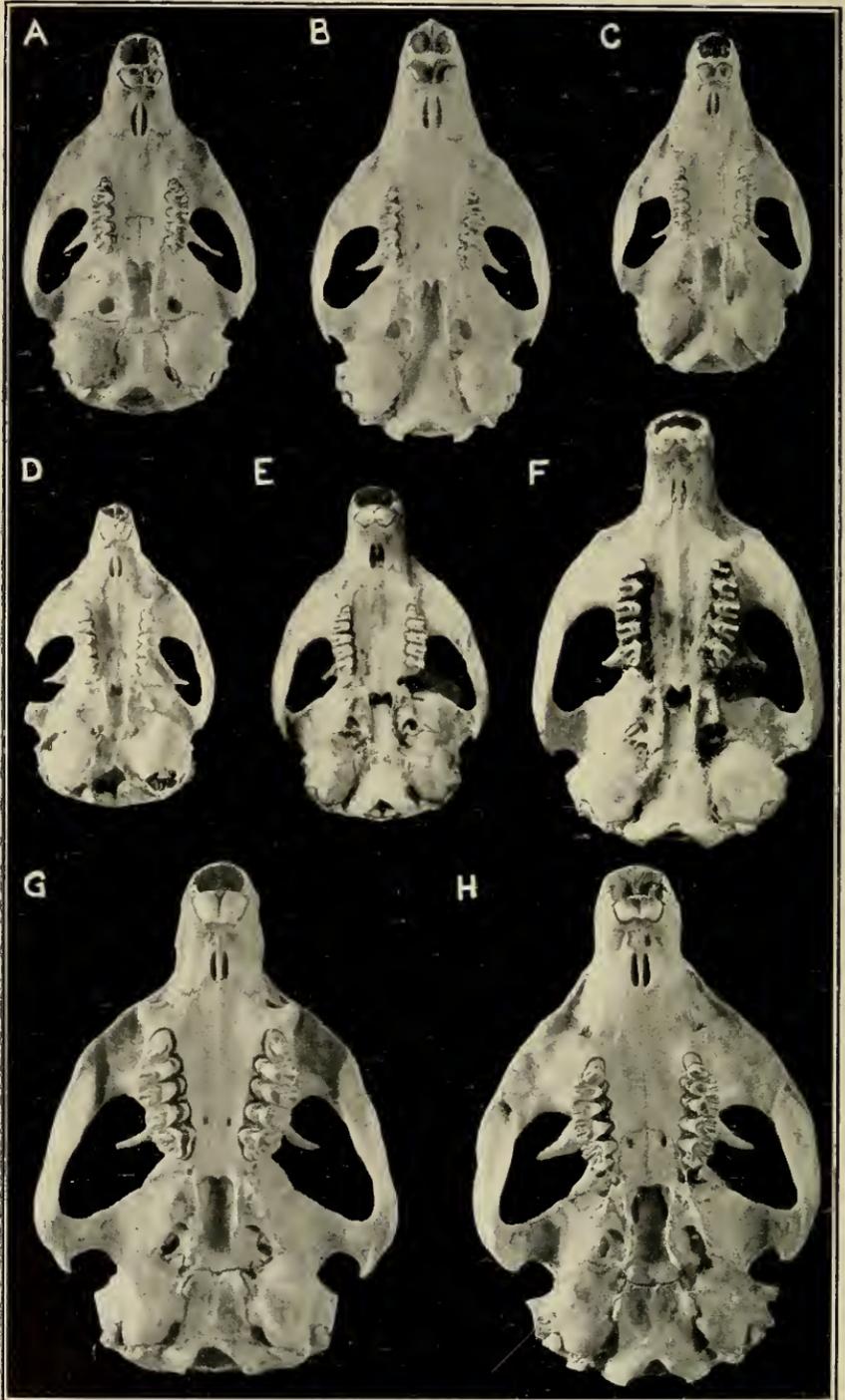
PLATE 16

(Natural size)

- A. *Synthosciurus brochus*.
- B. *Sciurus (Guerlinguetus) aestuans chiriquensis*.
- C. *Sciurus (Parasciurus) niger limitis*.
- D. *Tamiasciurus douglasii*.
- E. *Sciurus (Otosciurus) aberti*.
- F. *Sciurus (Sciurus) vulgaris*.



SKULLS OF SCIURUS, TAMIASCIURUS, AND SYNTHEOSCIURUS.



SKULLS OF CITELLUS AND CYNOMYS

PLATE 17

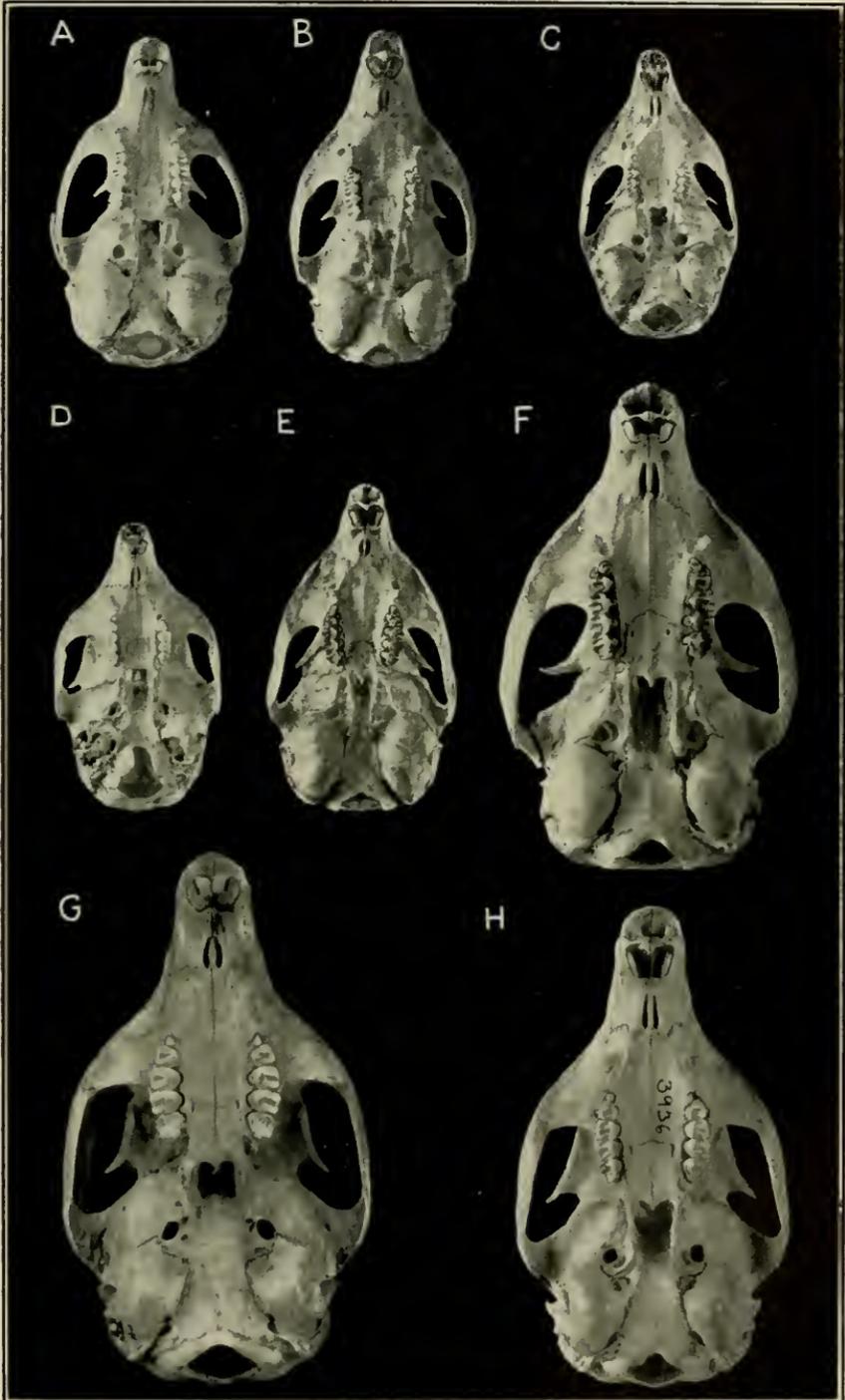
(Natural size)

- A. *Citellus* (*Callospermophilus*) *saturatus*.
- B. *Citellus* (*Poliocitellus*) *franklinii*.
- C. *Citellus* (*Ictidomys*) *tridecemlineatus*.
- D. *Citellus* (*Xerospermophilus*) *mohavensis*.
- E. *Citellus* (*Citellus*) *citellus*.
- F. *Citellus* (*Citellus*) *fulvus*.
- G. *Cynomys* (*Cynomys*) *ludovicianus*.
- H. *Citellus* (*Citellus*) *parryi*.

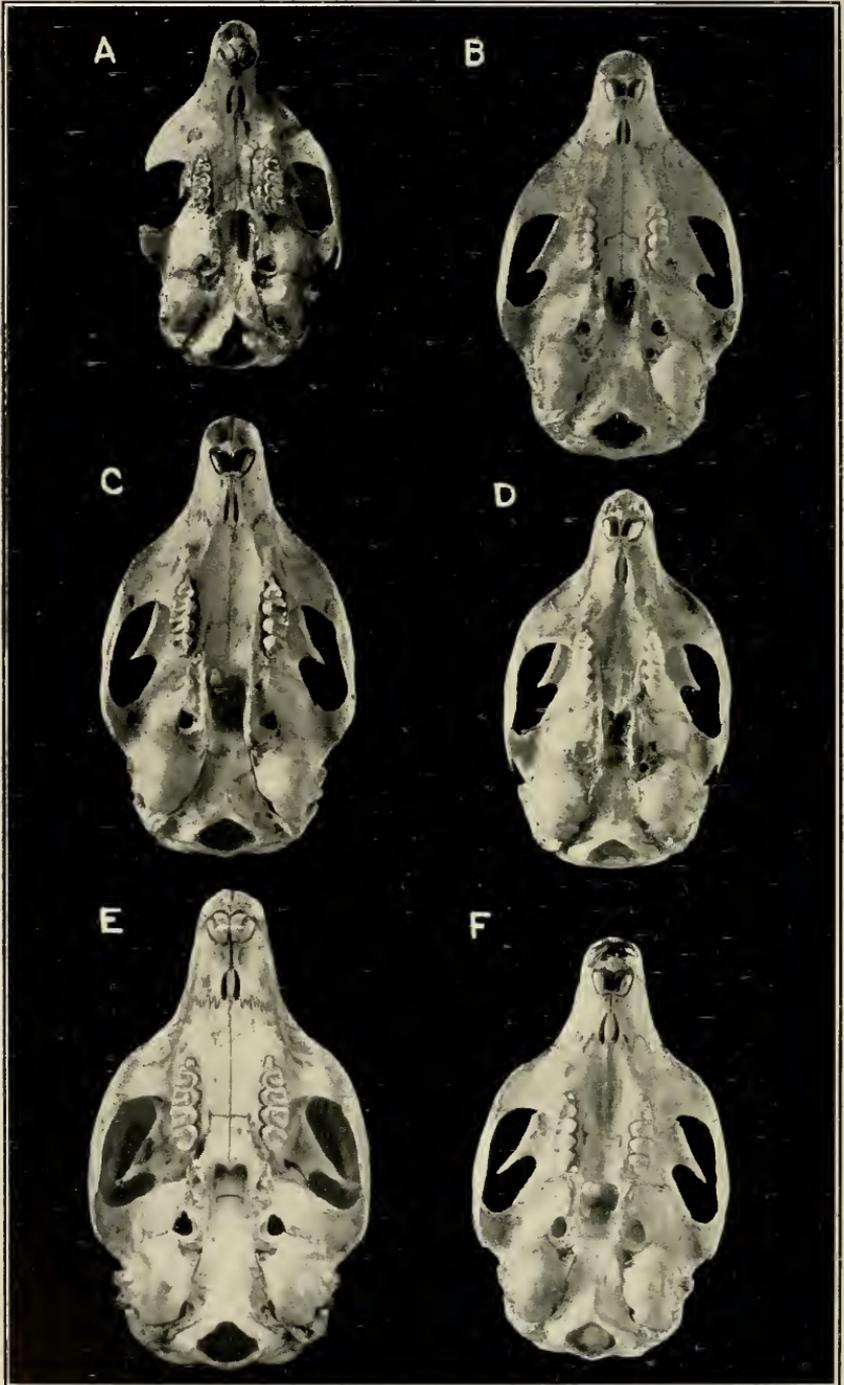
PLATE 18

(Natural size)

- A. *Glaucomys volans volans*.
- B. *Tamias striatus*.
- C. *Eutamias* (*Neotamias*) *dorsalis*.
- D. *Microsciurus brownii*.
- E. *Citellus* (*Ammospermophilus*) *harrisii*.
- F. *Citellus* (*Otospermophilus*) *variegatus grammurus*.
- G. *Sciurus* (*Hesperosciurus*) *griseus*.
- H. *Sciurus* (*Neosciurus*) *carolinensis*.



SKULLS OF GLAUCOMYS, TAMIAS, EUTAMIAS, SCIURUS, MICROSCIURUS, AND CITELLUS.



SKULLS OF SCIURUS, TAMIASCIURUS, AND SYNTHEOSCIURUS.

PLATE 19

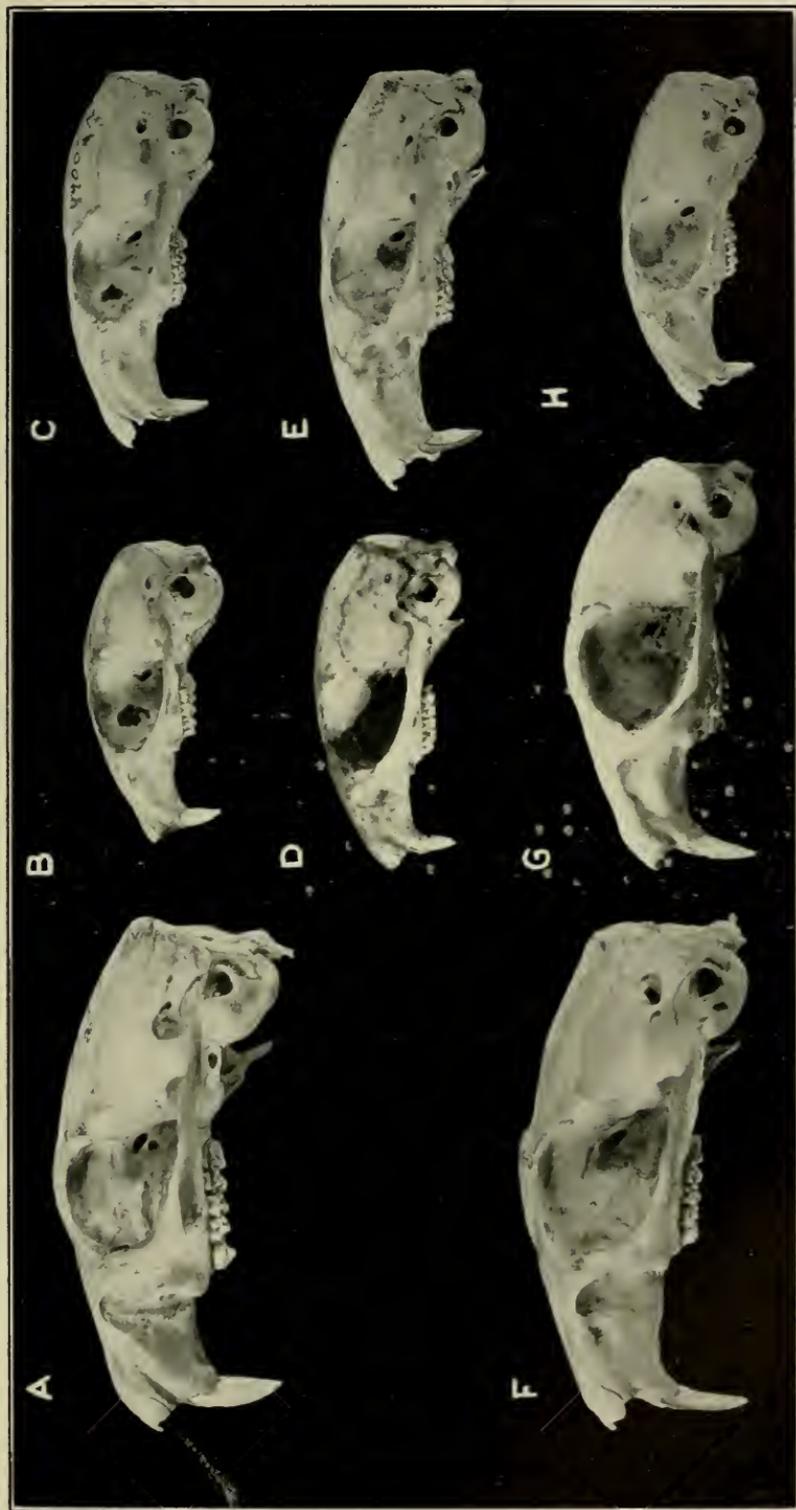
(Natural size)

- A. *Synthosciurus brochus*.
- B. *Sciurus (Guerlinguetus) aestuans chiriquensis*.
- C. *Sciurus (Parasciurus) niger limitis*.
- D. *Tamiasciurus douglasii*.
- E. *Sciurus (Otosciurus) aberti*.
- F. *Sciurus (Sciurus) vulgaris*.

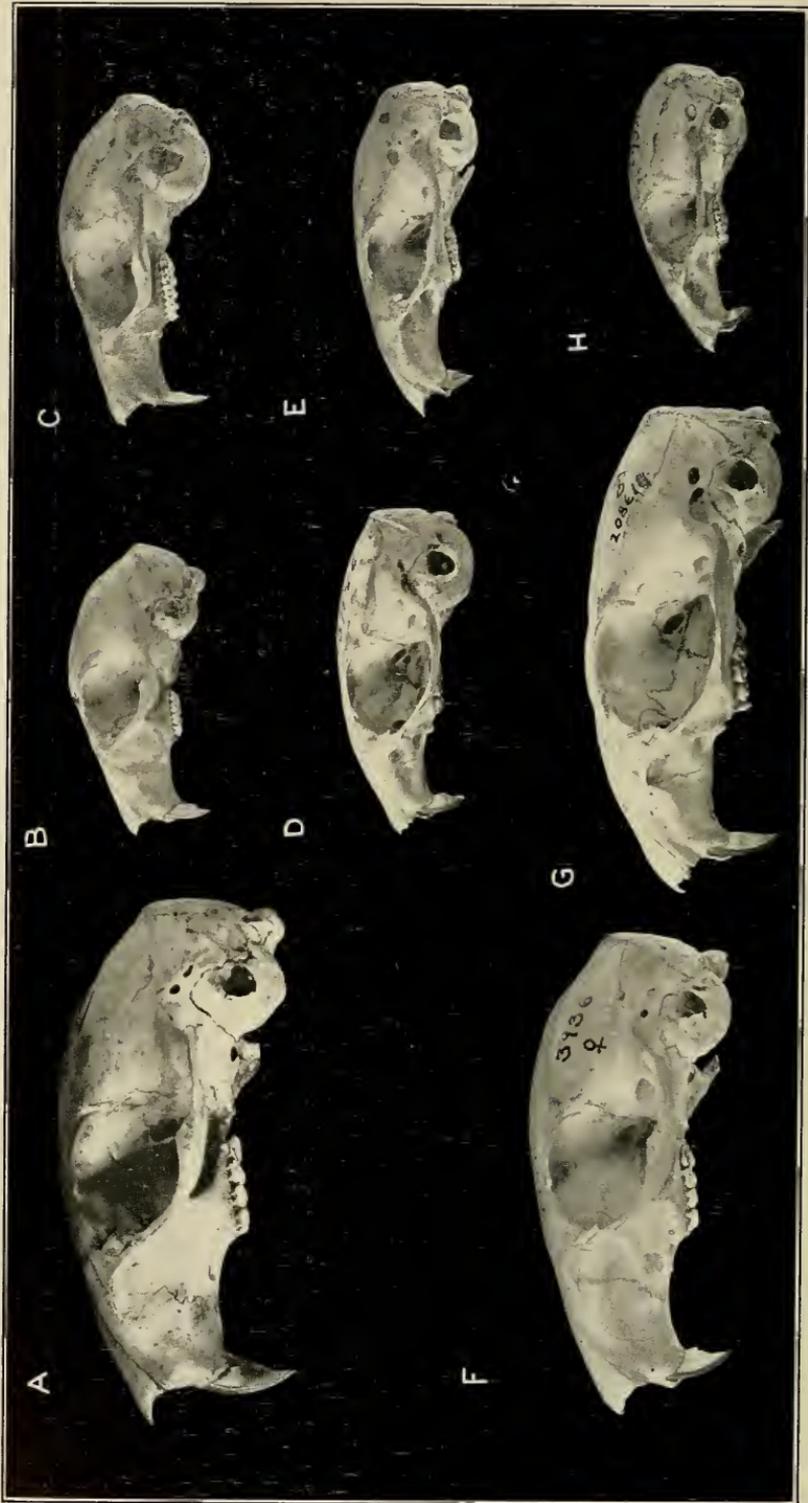
PLATE 20

(Natural size)

- A. *Cynomys (Cynomys) ludovicianus*.
- B. *Citellus (Xerospermophilus) mohavensis*.
- C. *Citellus (Callospermophilus) saturatus*.
- D. *Citellus (Citellus) citellus*.
- E. *Citellus (Poliocitellus) franklinii*.
- F. *Citellus (Citellus) parryi*.
- G. *Citellus (Citellus) fulvus*.
- H. *Citellus (Ictidomys) tridecemlineatus*.



SKULLS OF CITELLUS AND CYNOMYS.



SKULLS OF GLAUCOMYS, TAMIAS, EUTAMIAS, SCIURUS, MICROSCIURUS, AND CITELLUS.

PLATE 21

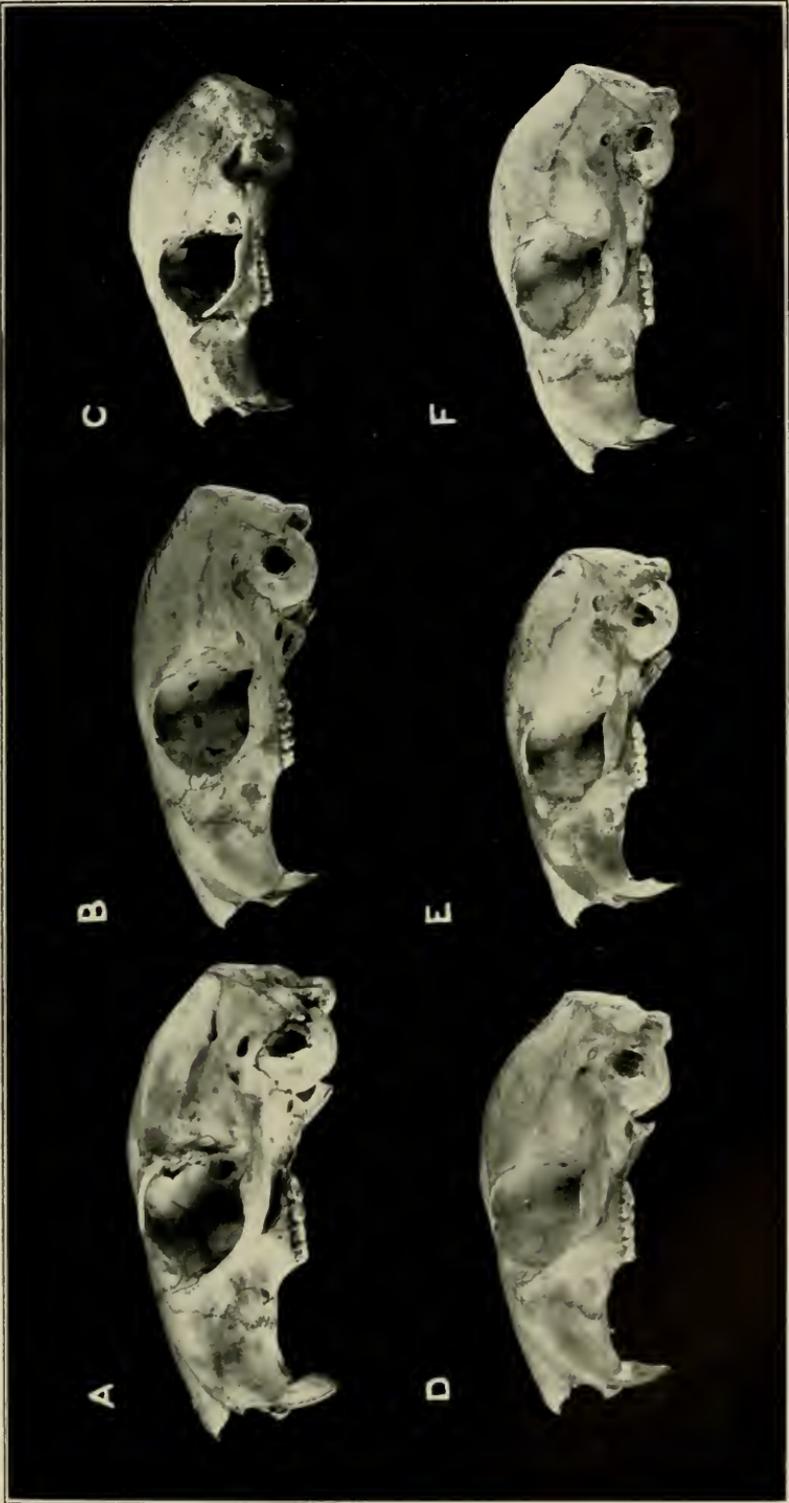
(Natural size)

- A. *Sciurus (Hesperosciurus) griseus.*
- B. *Microsciurus browni.*
- C. *Glaucomys volans.*
- D. *Citellus (Ammospermophilus) harrisi.*
- E. *Tamias striatus.*
- F. *Sciurus (Neosciurus) carolinensis.*
- G. *Citellus (Otospermophilus) variegatus grammurus.*
- H. *Eutamias (Neotamias) dorsalis.*

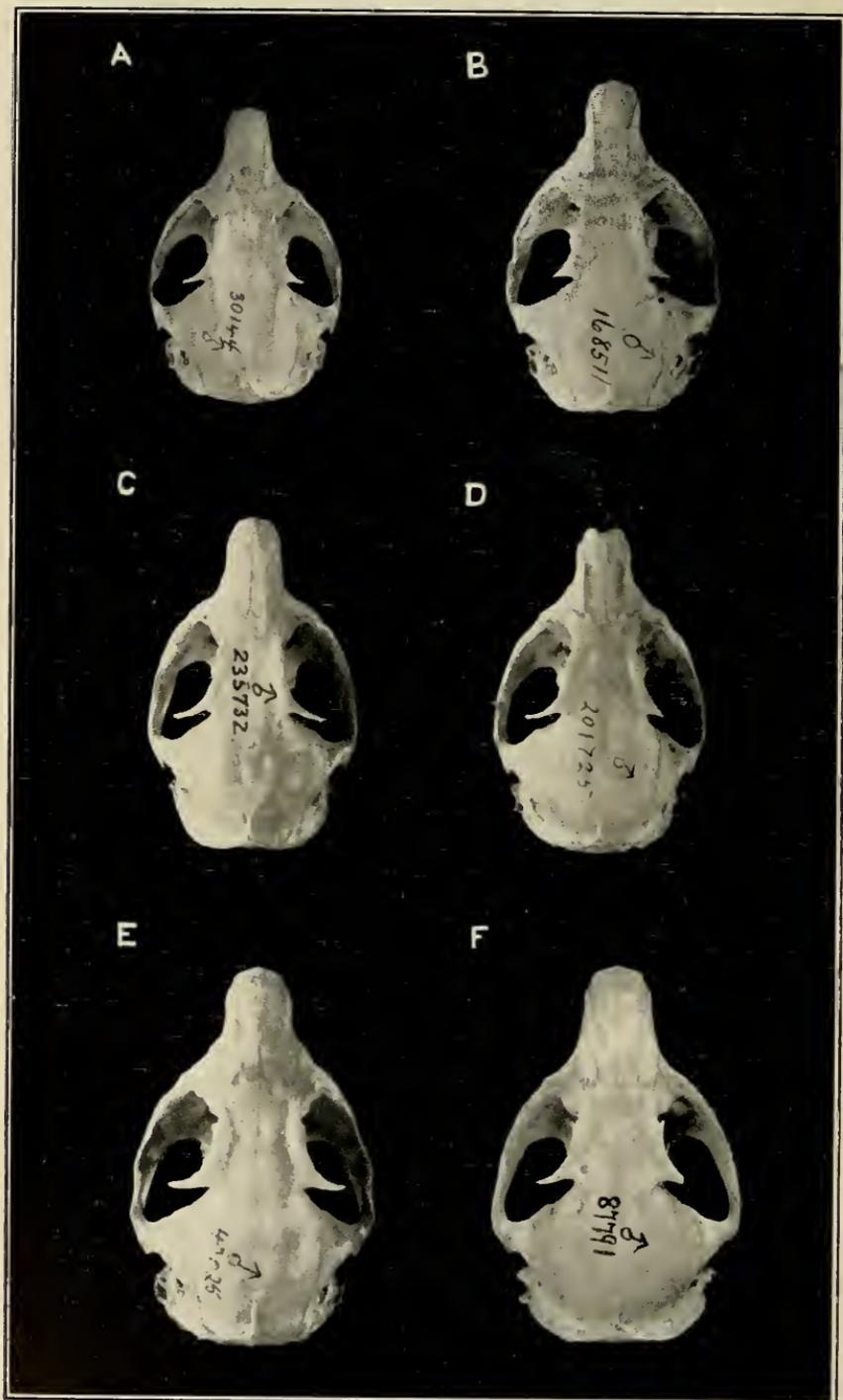
PLATE 22

(Natural size)

- A. *Sciurus (Otosciurus) aberti*.
- B. *Sciurus (Parasciurus) niger*.
- C. *Synthosciurus brochus*.
- D. *Sciurus (Sciurus) vulgaris*.
- E. *Tamiasciurus douglasii*.
- F. *Sciurus (Guerlinguctus) acstuanus*.



SKULLS OF SCIURUS, TAMIASCIURUS, AND SYNTHEOSCIURUS.



SKULLS OF CITELLUS.

PLATE 23

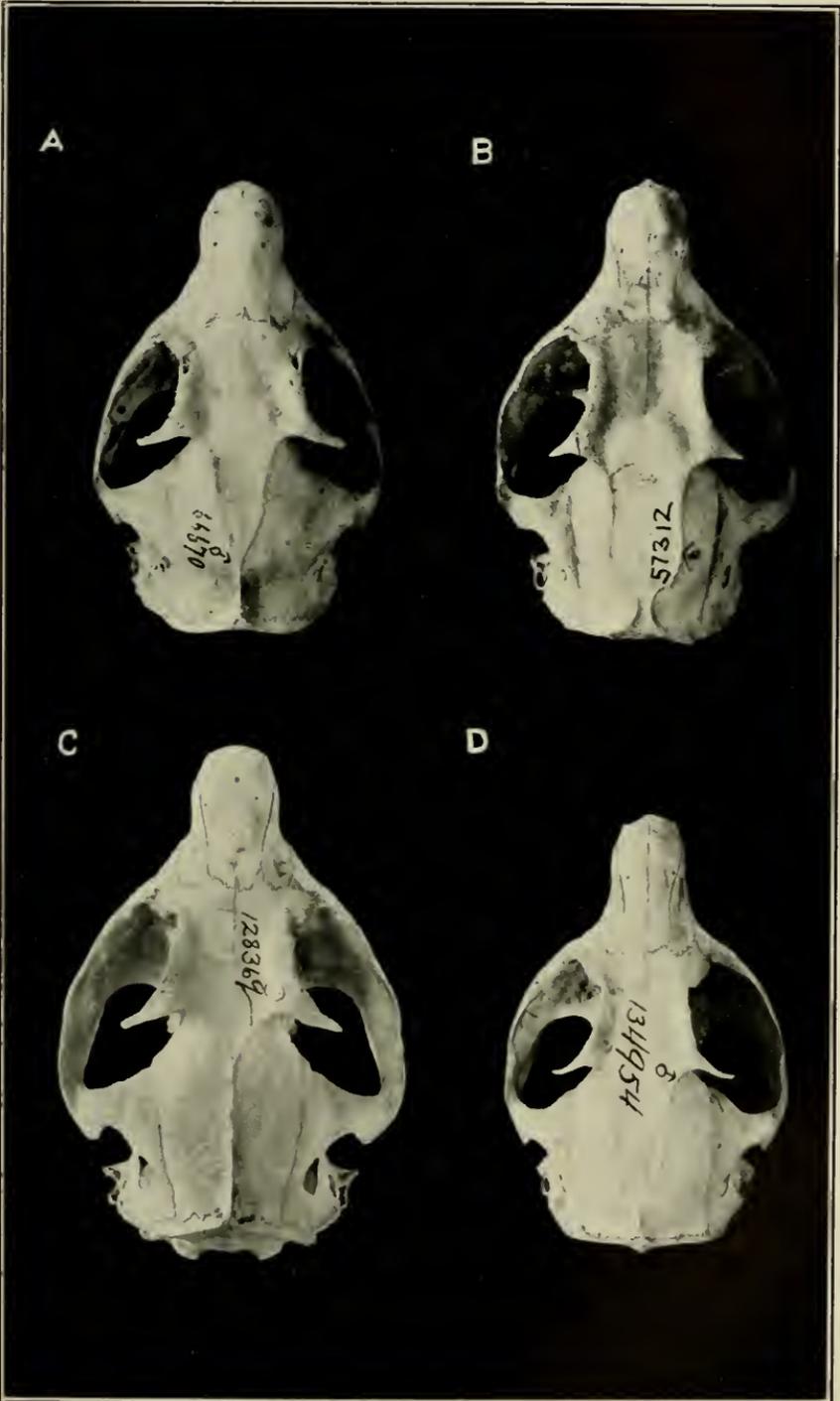
(Natural size)

- A. *Citellus townsendii mollis*, ♂ ad., Fairfield, Utah (no. 30144, U. S. Natl. Mus., Biological Survey collection).
- B. *Citellus idahocnsis*, ♂ ad., Nampa, Idaho (no. 168511, U. S. Natl. Mus., Biological Survey collection).
- C. *Citellus washingtoni washingtoni*, ♂ ad., Wallula, Wash. (no. 235732, U. S. Natl. Mus., Biological Survey collection).
- D. *Citellus brunneus*, ♂ ad., Weiser, Idaho (no. 201725, U. S. Natl. Mus., Biological Survey collection).
- E. *Citellus beldingi beldingi*, ♂ ad., Mammoth Pass, Calif. (no. 42025, U. S. Natl. Mus., Biological Survey collection).
- F. *Citellus armatus*, ♂ ad., Barclay, Utah (no. 87791, U. S. Natl. Mus., Biological Survey collection).

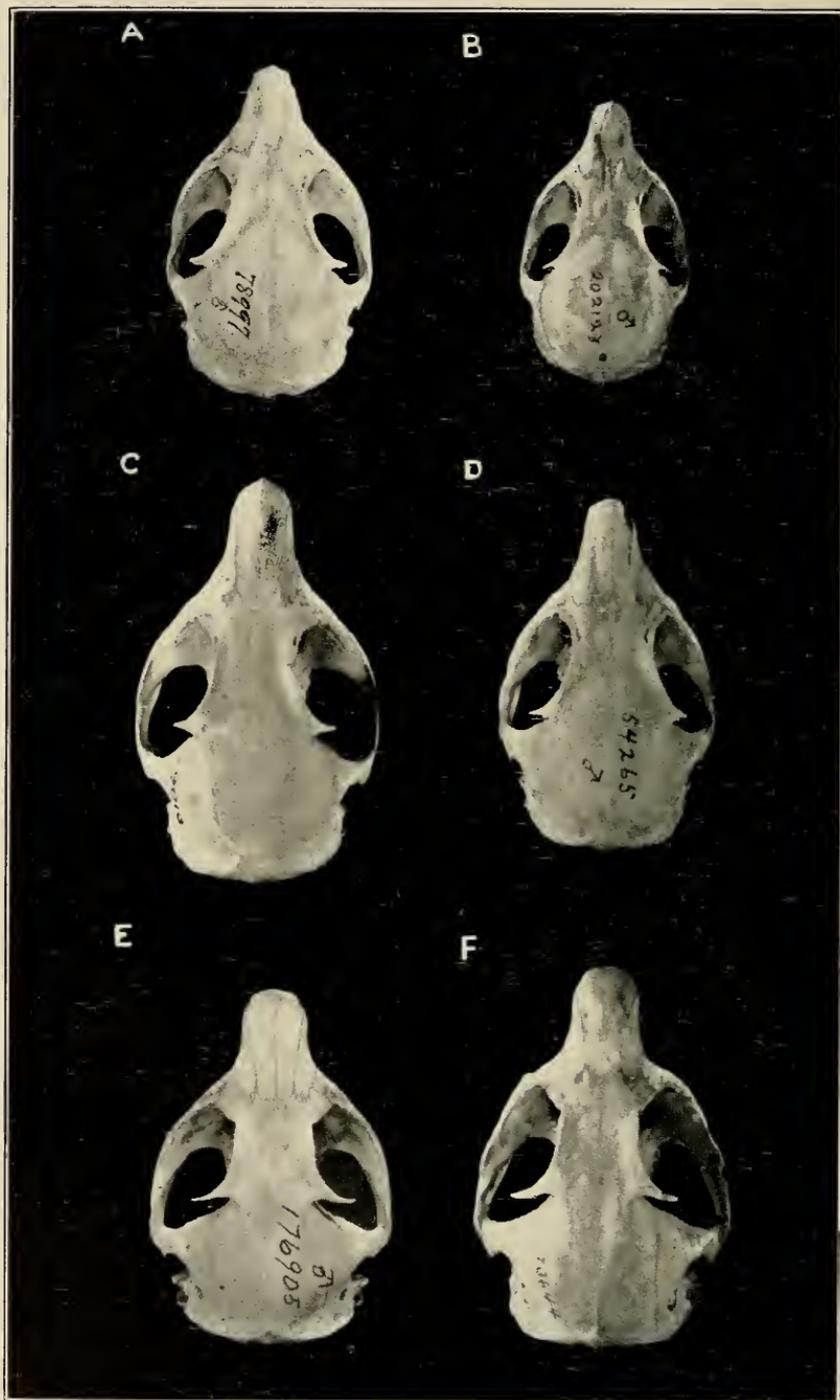
PLATE 24

(Natural size)

- A. *Citellus columbianus columbianus*, ♂ ad., Nelson, British Columbia (no. 66670, U. S. Natl. Mus., Biological Survey collection).
- B. *Citellus parryi lyratus*, ♂ ad., St. Lawrence Island, Bering Sea (no. 57312, Mus. Vert. Zool.).
- C. *Citellus osgoodi*, ♂ ad., Circle, Alaska (no. 128269, U. S. Natl. Mus., Biological Survey collection).
- D. *Citellus parryi plesius*, ♂ ad., Head of Coal Creek, Yukon (no. 134954, U. S. Natl. Mus., Biological Survey collection).



SKULLS OF CITELLUS.



SKULLS OF CITELLUS.

PLATE 25

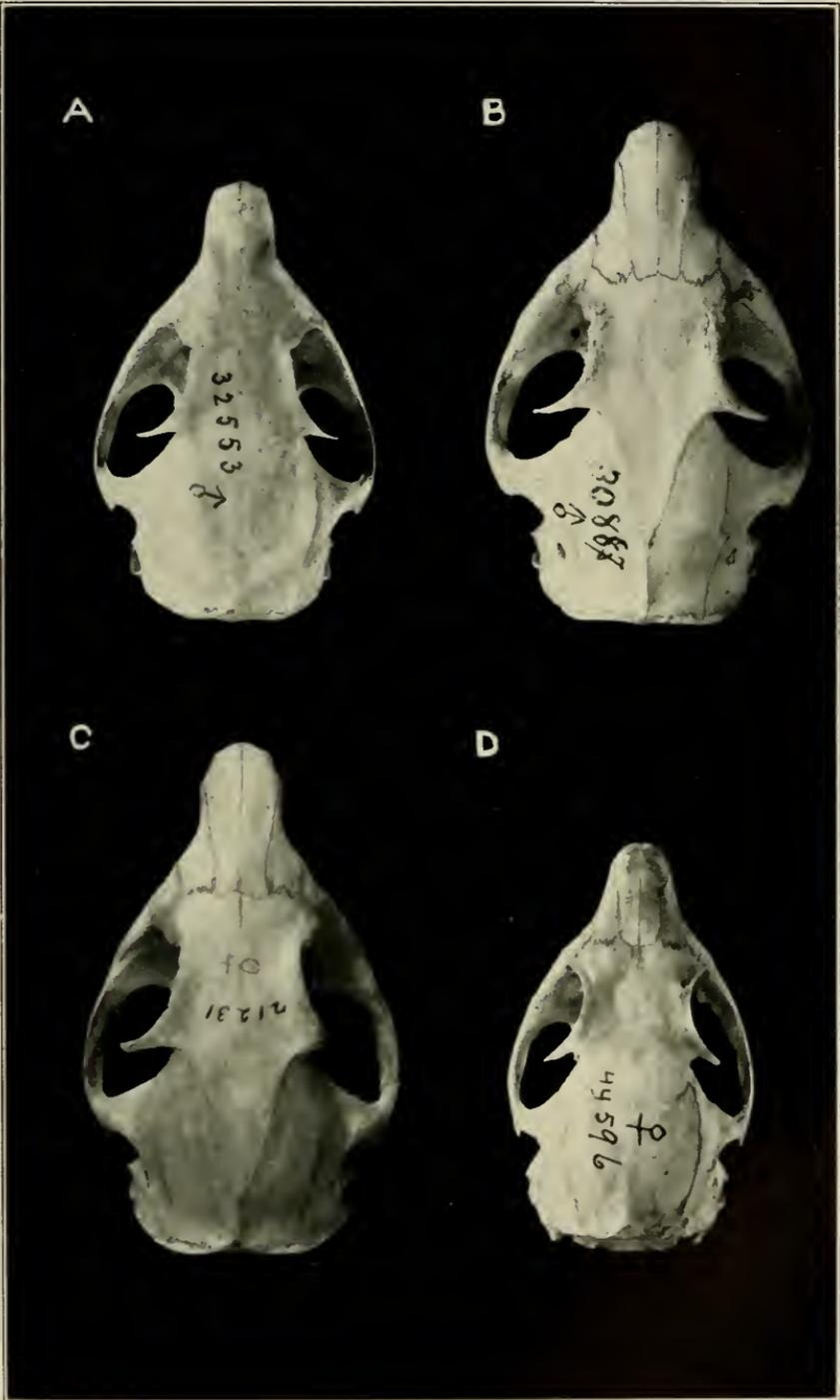
(Natural size)

- A. *Citellus spilosoma spilosoma*, ♂ ad., Chicalote, Aguascalientes, Mexico (no. 78997, U. S. Natl. Mus., Biological Survey collection).
- B. *Citellus spilosoma pratensis*, ♂ subadult, Flagstaff, Ariz. (no. 202123, U. S. Natl. Mus., Biological Survey collection).
- C. *Citellus mexicanus mexicanus*, ♂ ad., Silao, Guanajuato, Mexico (no. 79018, U. S. Natl. Mus., Biological Survey collection).
- D. *Citellus perotensis*, ♂ ad., Perote, Vera Cruz (no. 54265, U. S. Natl. Mus., Biological Survey collection).
- E. *Citellus richardsonii elegans*, ♂ ad., Pinedale, Wyo. (no. 176905, U. S. Natl. Mus., Biological Survey collection).
- F. *Citellus richardsonii richardsonii*, ♂ ad., Wingard, Saskatchewan (no. 73644, U. S. Natl. Mus., Biological Survey collection).

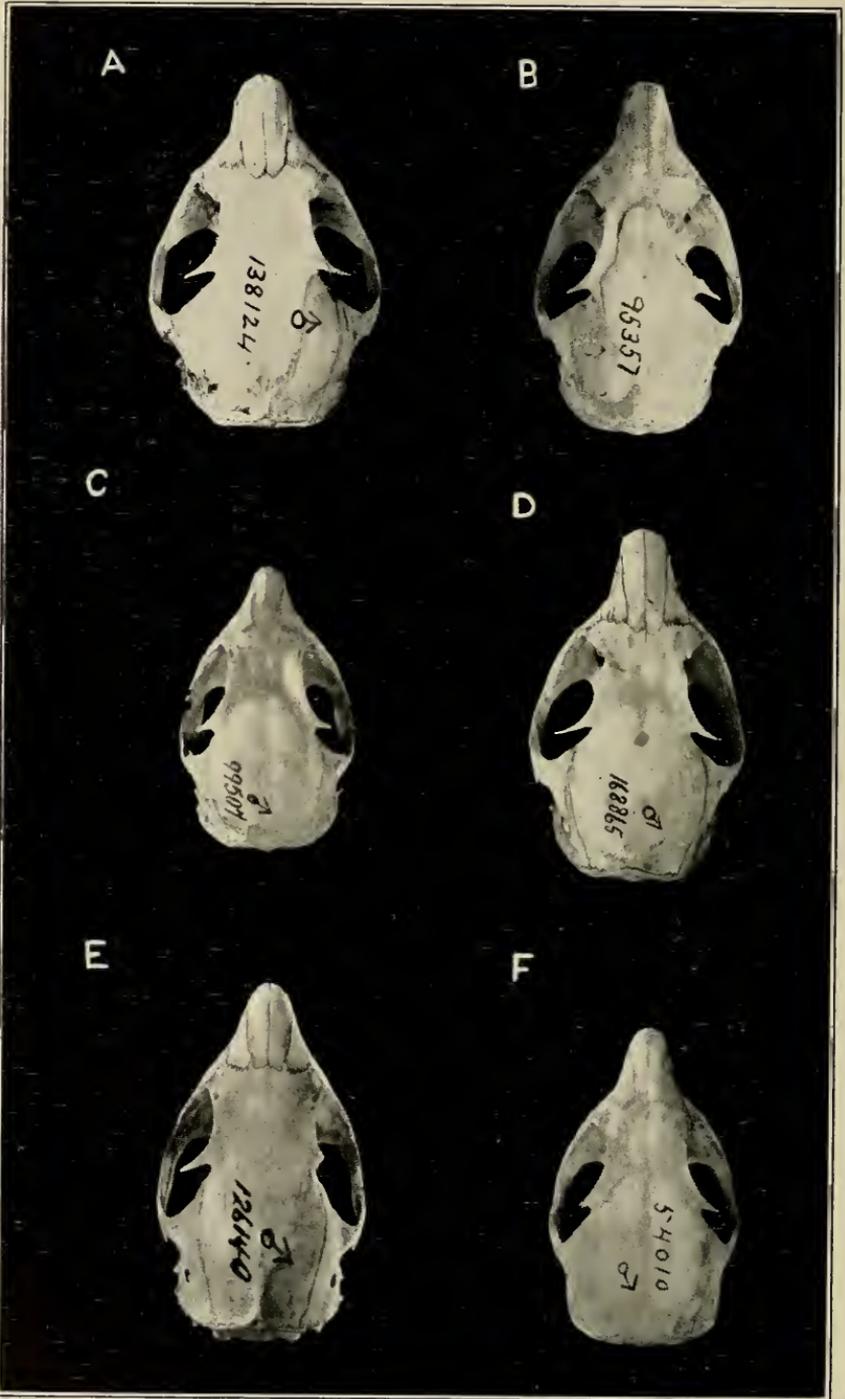
PLATE 26

(Natural size)

- A. *Citellus beecheyi parvulus*, ♂ subadult, Lone Pine, Calif. (no. 32553, U. S. Natl. Mus., Biological Survey collection).
- B. *Citellus beecheyi douglasii*, ♂ ad., Forest Grove, Oreg. (no. 30887, U. S. Natl. Mus., Biological Survey collection).
- C. *Citellus variegatus rupestris*, ♀ ad. (type), Rio Sestin, Durango (no. 21231, Amer. Mus. Nat. Hist.).
- D. *Citellus annulatus annulatus*, ♂ ad., Manzanillo, Colima, Mexico (no. 44596, U. S. Natl. Mus., Biological Survey collection).



SKULLS OF CITELLUS.



SKULLS OF CITELLUS.

PLATE 27

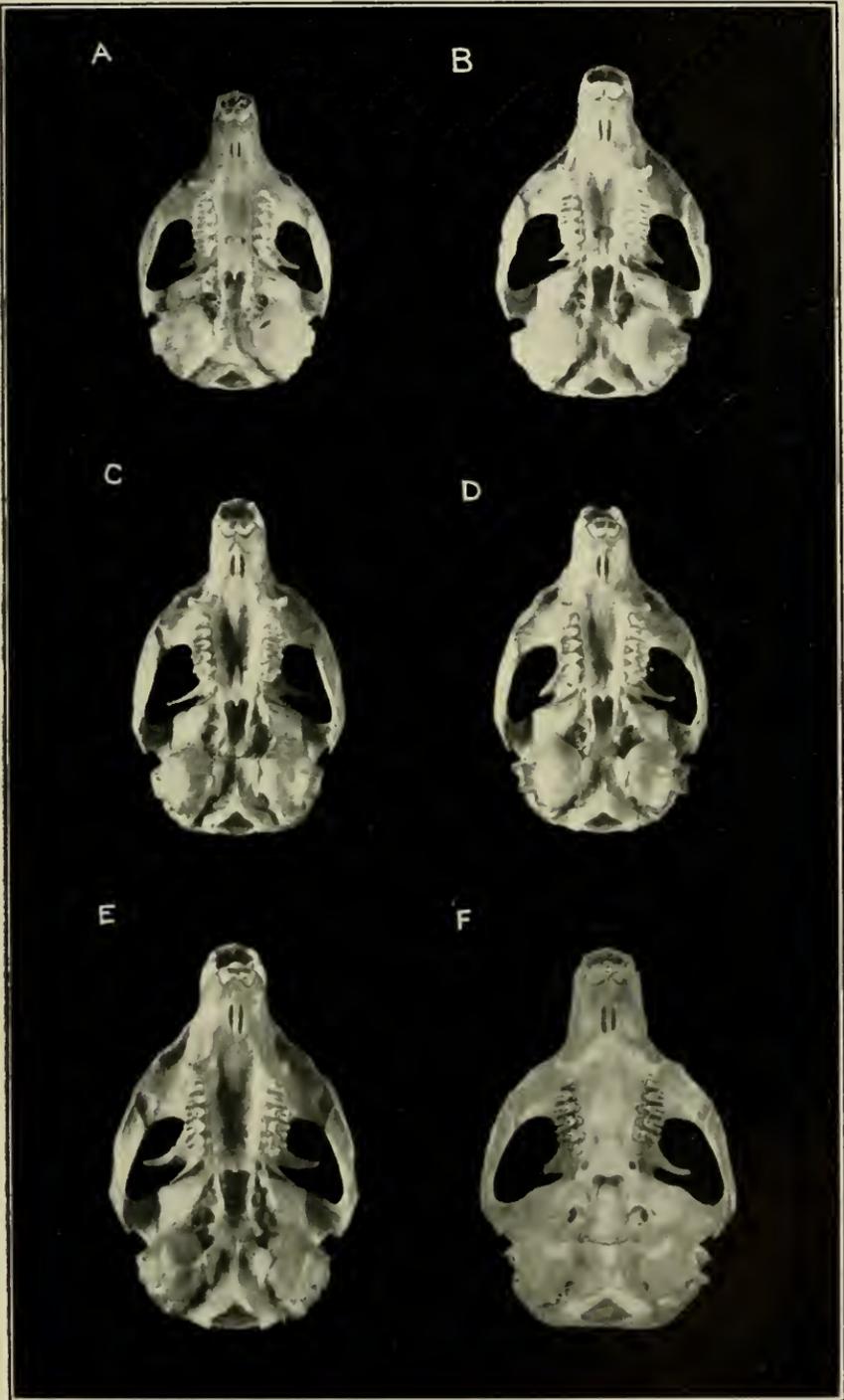
(Natural size)

- A. *Citellus lateralis mitratus*, ♂ ad., South Yolla Bolly Mountain, Calif. (no. 138124, U. S. Natl. Mus., Biological Survey collection).
- B. *Citellus madrensis*, ♂ ad., Sierra Madre, near Guadalupe y Calvo, Chihuahua, Mexico (no. 95357, U. S. Natl. Mus., Biological Survey collection).
- C. *Citellus tereticaudus tereticaudus*, ♂ ad., Fort Yuma, Calif. (no. 99507, U. S. Natl. Mus., Biological Survey collection).
- D. *Citellus lateralis lateralis*, ♂ ad., Hahns Peak, Colo. (no. 168865, U. S. Natl. Mus., Biological Survey collection).
- E. *Citellus adocetus*, ♂ ad., La Salada, Michoacan, Mexico (no. 126140, U. S. Natl. Mus., Biological Survey collection).
- F. *Citellus leucurus leucurus*, ♂ ad., Cabazon, Calif. (no. 54010, U. S. Natl. Mus., Biological Survey collection).

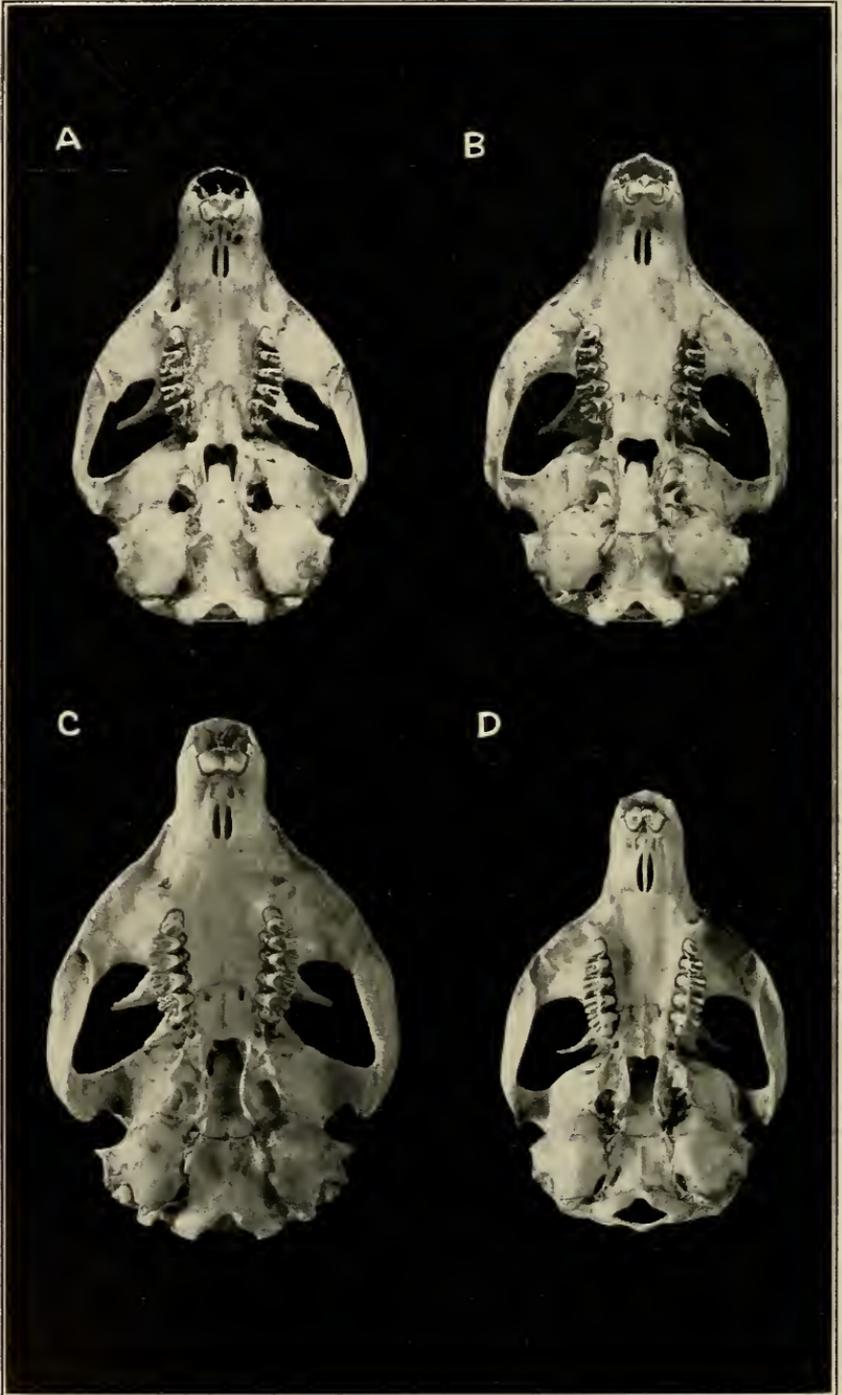
PLATE 28

(Natural size)

- A. *Citellus townsendii mollis*, ♂ ad., Fairfield, Utah, (no. 30144, U. S. Natl. Mus., Biological Survey collection).
- B. *Citellus idahocensis*, ♂ ad., Nampa, Idaho (no. 168511, U. S. Natl. Mus., Biological Survey collection).
- C. *Citellus washingtoni washingtoni*, ♂ ad., Wallula, Wash. (no. 235732, U. S. Natl. Mus., Biological Survey collection).
- D. *Citellus brunneus*, ♂ ad., Weiser, Idaho (no. 201725, U. S. Natl. Mus., Biological Survey collection).
- E. *Citellus beldingi beldingi*, ♂ ad., Mammoth Pass, Calif. (no. 42025, U. S. Natl. Mus., Biological Survey collection).
- F. *Citellus armatus*, ♂ ad., Barclay, Utah (no. 87791, U. S. Natl. Mus., Biological Survey collection).



SKULLS OF CITELLUS.



SKULLS OF CITELLUS.

PLATE 29

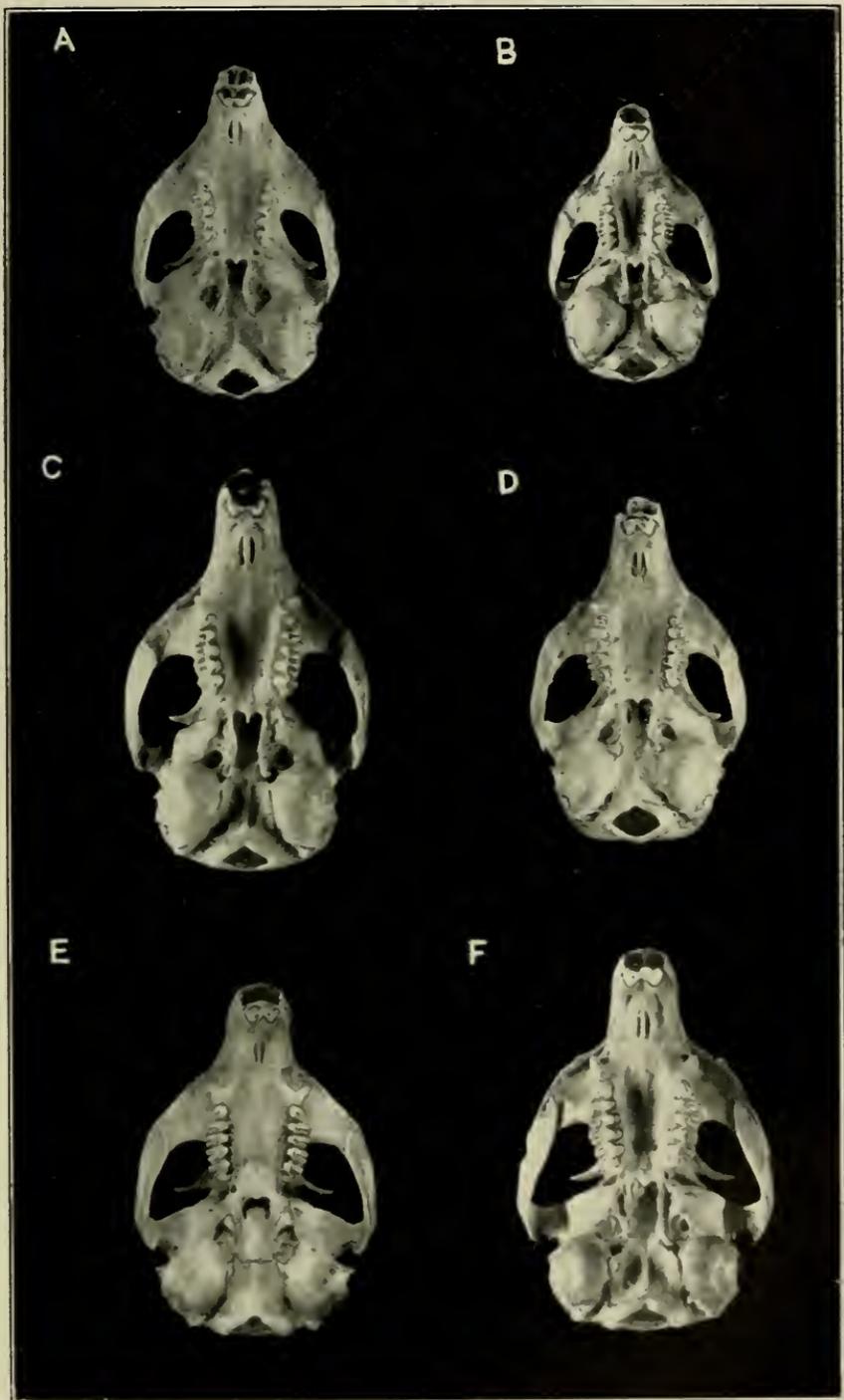
(Natural size)

- A. *Citellus columbianus columbianus*, ♂ ad., Nelson, British Columbia (no. 66670, U. S. Natl. Mus., Biological Survey collection).
- B. *Citellus parryii lyratus*, ♂ ad., St. Lawrence Island, Bering Sea (no. 57312, Mus. Vert. Zool.).
- C. *Citellus osgoodi*, ♂ ad., Circle, Alaska (no. 128369, U. S. Natl. Mus., Biological Survey collection).
- D. *Citellus parryii plesius*, ♂ ad., Head of Coal Creek, Yukon (no. 134954, U. S. Natl. Mus., Biological Survey collection).

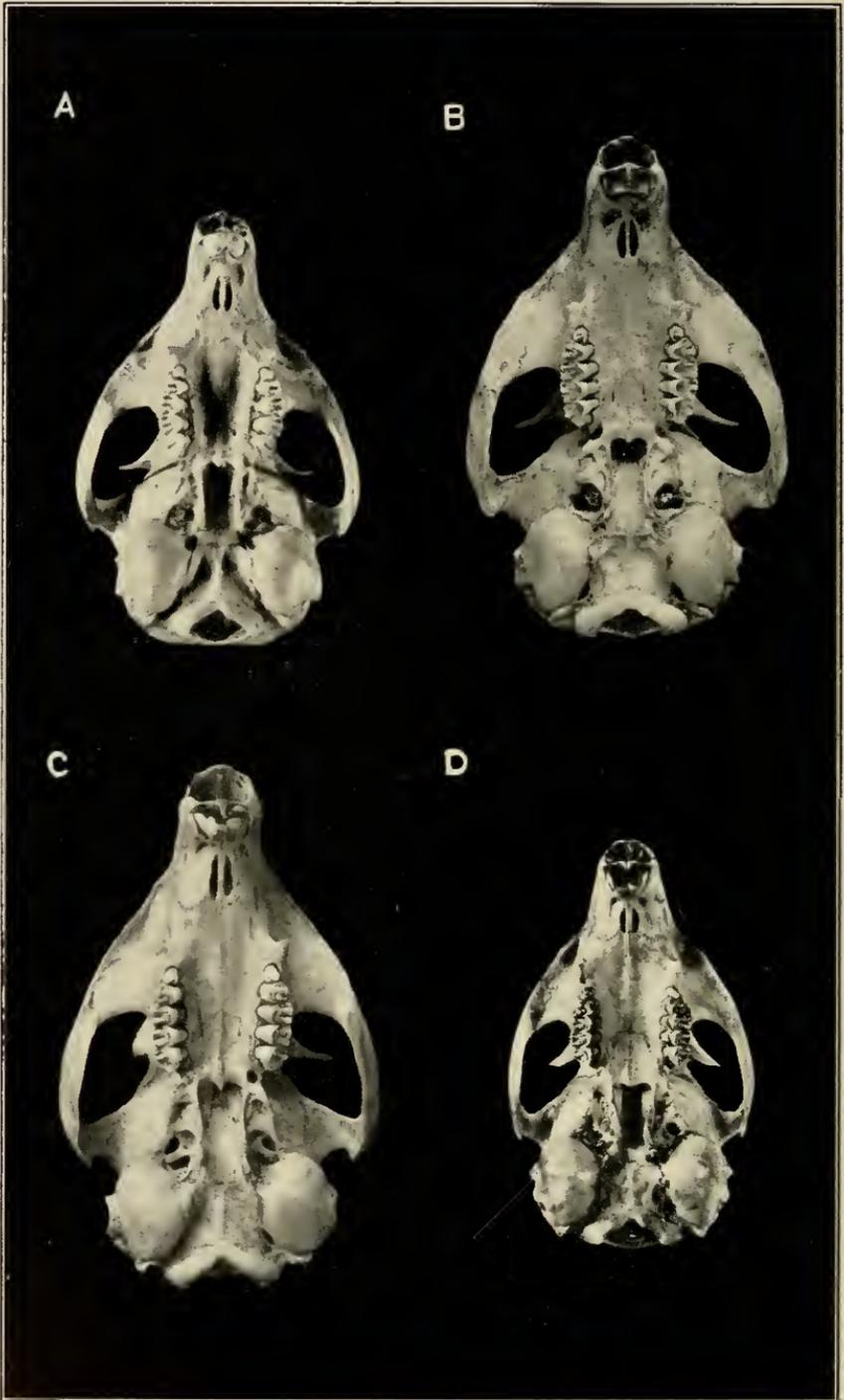
PLATE 30

(Natural size)

- A. *Citellus spilosoma spilosoma*, ♂ ad., Chicalote, Aguascalientes, Mexico (no. 78997, U. S. Natl. Mus., Biological Survey collection).
- B. *Citellus spilosoma pratensis*, ♂ subadult, Flagstaff, Ariz. (no. 202123, U. S. Natl. Mus., Biological Survey collection).
- C. *Citellus mexicanus mexicanus*, ♂ ad., Silao, Guanajuato, Mexico (no. 79108, U. S. Natl. Mus., Biological Survey collection).
- D. *Citellus perotensis*, ♂ ad., Perote, Vera Cruz (no. 54265, U. S. Natl. Mus., Biological Survey collection).
- E. *Citellus richardsonii elegans*, ♂ ad., Pinedale, Wyo. (no. 176905, U. S. Natl. Mus., Biological Survey collection).
- F. *Citellus richardsonii richardsonii*, ♂ ad., Wingard, Saskatchewan (no. 73644, U. S. Natl. Mus., Biological Survey collection).



SKULLS OF CITELLUS.



SKULLS OF CITELLUS.

PLATE 31

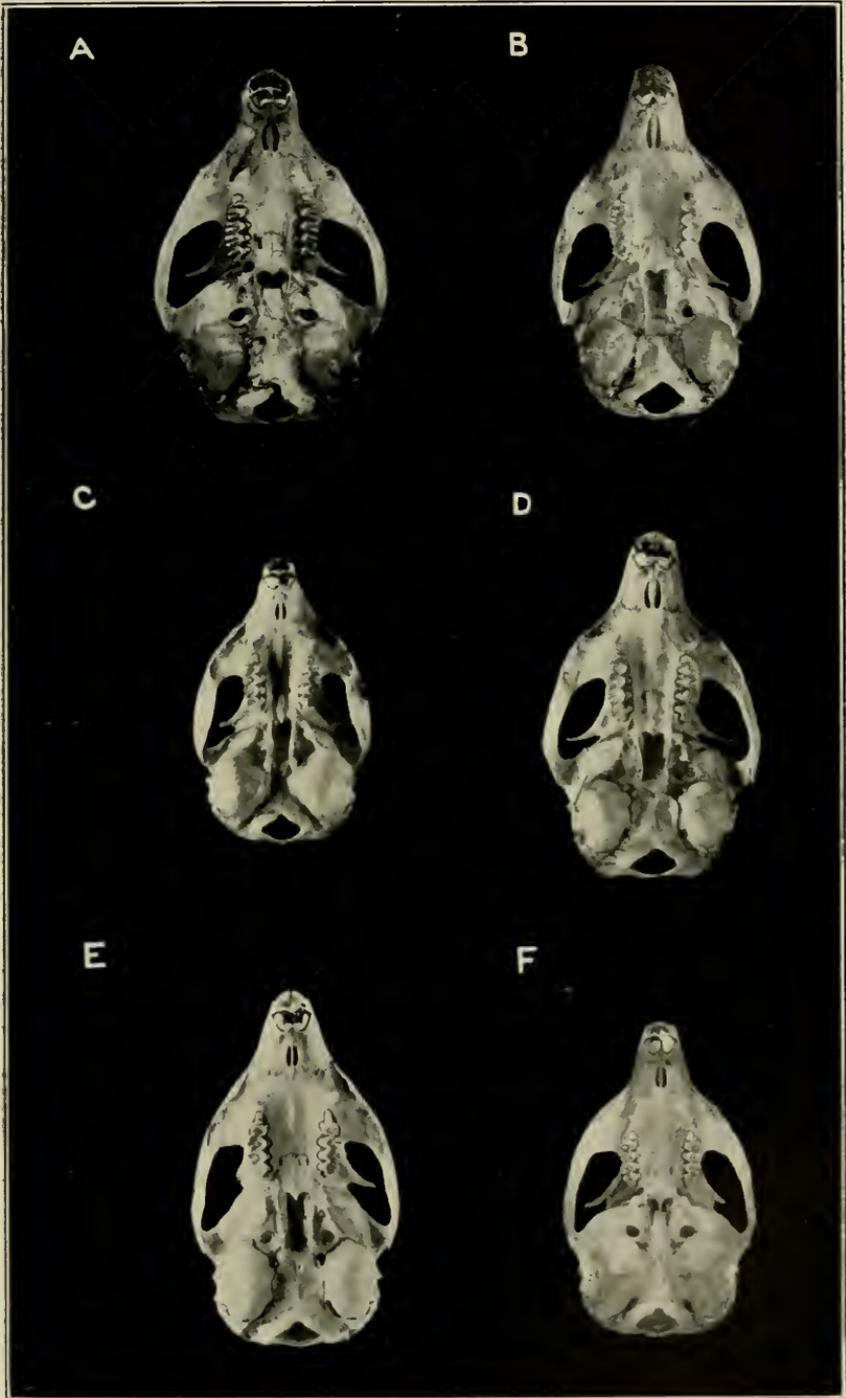
(Natural size)

- A. *Citellus beecheyi parvulus*, ♂ subadult, Lone Pine, Calif. (no. 32553, U. S. Natl. Mus., Biological Survey collection).
- B. *Citellus beecheyi douglasii*, ♂ ad., Forest Grove, Oreg. (no. 30887, U. S. Natl. Mus., Biological Survey collection).
- C. *Citellus variegatus rupestris*, ♀ ad. (type), Rio Sestin, Durango (no. 21231, Amer. Mus. Nat. Hist.).
- D. *Citellus annulatus annulatus*, ♂ ad., Manzanillo, Colima, Mexico (no. 44596, U. S. Natl. Mus., Biological Survey collection).

PLATE 32

(Natural size)

- A. *Citellus lateralis mitratus*, ♂ ad., South Yolla Bolly Mountain, Calif. (no. 138124, U. S. Natl. Mus., Biological Survey collection).
- B. *Citellus madrensis*, ♂ ad., Sierra Madre, near Guadalupe y Calvo, Chihuahua, Mexico (no. 95357, U. S. Natl. Mus., Biological Survey collection).
- C. *Citellus tereticaudus tereticaudus*, ♂ ad., Fort Yuma, Calif. (no. 99507, U. S. Natl. Mus., Biological Survey collection).
- D. *Citellus lateralis lateralis*, ♂ ad., Hahns Peak, Colo. (no. 168865, U. S. Natl. Mus., Biological Survey collection).
- E. *Citellus adocetus*, ♂ ad., La Salada, Michoacan, Mexico (no. 126140, U. S. Natl. Mus., Biological Survey collection).
- F. *Citellus leucurus leucurus*, ♂ ad., Cabazon, Calif. (no. 54010, U. S. Natl. Mus., Biological Survey collection).



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- \*No. 36. *Revision of the American Harvest Mice (Genus Reithrodontomys)*. By ARTHUR H. HOWELL.  
Pp. 97, pls. 7, figs. 6 (maps). 1914.
- \*No. 37. *Revision of the American Marmots*. By ARTHUR H. HOWELL.  
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- \*No. 38. *A Review of the American Moles*. By HARTLEY H. T. JACKSON.  
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- \*No. 40. *A Systematic Account of the Prairie-Dogs*. By N. HOLLISTER.  
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- \*No. 41. *Review of the Grizzly and Big Brown Bears of North America (Genus Ursus), with Description of a New Genus, Vetularctos*. By C. HART MERRIAM.  
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- \*No. 44. *Revision of the American Flying Squirrels*. By ARTHUR H. HOWELL.  
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Pp. 88, pls. 11 (incl. 1 colored map), figs. 10 (maps). 1921.
- \*No. 46. *A Biological Survey of the Pribilof Islands Alaska: I, Birds and Mammals*, by EDWARD A. PEEBLE and W. L. MCATEE. *II, Insects, Arachnids, and Chilopods*, by various entomologists, with an introduction by W. L. MCATEE.  
Pp. 255, pls. 15 (incl. 3 maps). 1923.
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Pp. 57, pls. 6, figs. 4 (maps). 1924. Price 15 cents.
- No. 48. *Voles of the Genus Phenacomys: I, Revision of the Genus Phenacomys. II, Life History of the Red Tree Mouse (Phenacomys longicaudus)*. By A. BRAZIER HOWELL.  
Pp. 64, pls. 7, figs. 11 (incl. 5 maps). 1926. Price 20 cents.
- \*No. 49. *A Biological Survey of North Dakota: I, Physiography and Life Zones. II, The Mammals*. By VERNON BAILEY.  
Pp. 226, pls. 21 (incl. 1 colored map), figs. 8 (maps). 1926.
- No. 50. *Revision of the American Lemming Mice (Genus Synaptomys)*. By A. BRAZIER HOWELL.  
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- No. 52. *Revision of the American Chipmunks (Genera Tamias and Eutamias)*. By ARTHUR H. HOWELL.  
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- No. 53. *Mammals of New Mexico*. By VERNON BAILEY.  
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- No. 54. *Alaska-Yukon Caribou*. By OLAV J. MURIE.  
Pp. 93, pls. 10, figs. 16 (incl. 3 maps). 1935. Price 20 cents.
- No. 55. *The Mammals and Life Zones of Oregon*. By VERNON BAILEY.  
Pp. 418, pls. 52 (incl. 1 colored map), figs. 102 (incl. 96 maps). 1936. Price 75 cents.
- No. 56. *Revision of the North American Ground Squirrels, with a Classification of the North American Scuriidae*. By ARTHUR H. HOWELL.  
Pp. 256, pls. 32, figs. 20, 1938. Price 40 cents.





UNITED STATES DEPARTMENT OF THE INTERIOR

Harold L. Ickes, Secretary

FISH AND WILDLIFE SERVICE

Ira N. Gabrielson, Director

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# ATTWATER'S PRAIRIE CHICKEN ITS LIFE HISTORY AND MANAGEMENT

BY

VALGENE W. LEHMANN



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#### ABSTRACT

**A**TTWATER'S PRAIRIE CHICKEN, a characteristic bird of the Texas coastal prairie, is closely related to the now extinct heath-hen of northeastern North America. Once abundant in an area extending from the coastal tall-grass prairies of southwestern Louisiana and Texas west and south to near Port Isabel, it has decreased in numbers as man has exploited its habitat, until now it is threatened with the same fate as that of the heath-hen.

Important factors limiting the numbers of the bird include excessive or persistent rainfall during the nesting season, heavy grazing, excessive pasture burning, agricultural operations, and overshooting. Management will usually involve protection from excessive killing, improvement of food and cover, and control of predators and of the kill by hunters. Responsibility for this rests with the landowner.

Optimum prairie chicken range apparently consists of well-drained grassland, with some weeds or shrubs, the cover varying in density from light to heavy; and with surface water available in summer; diversification within the grassland type is essential. In the absence of ample refuges for the species, probably all other favorable factors together will fail to save Attwater's prairie chicken from extinction.

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# ATTWATER'S PRAIRIE CHICKEN

By VALGENE W. LEHMANN

Collaborator, Division of Wildlife Research, Fish and Wildlife Service<sup>1</sup>

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## INTRODUCTION

Attwater's prairie chicken (*Tympanuchus cupido attwateri* Bendire) (see frontispiece), might well be called the heath-hen of the South. It is so closely related to the now extinct heath-hen (*T. c. cupido*) of northeastern North America as to be classified in the same species. Like the heath-hen, Attwater's prairie chicken once inhabited a large area, its former range including the coastal tall-grass (*Andropogon*) prairies of southwestern Louisiana and in Texas west and south to Cameron County, near Port Isabel. In certain areas the birds were abundant. Old-timers report that the deep booming courtship calls of the males once reverberated from the prairies with such force and monotony as actually to pain sensitive eardrums. The bird, however, is no longer abundant. It has decreased in numbers as man has exploited its habitat until now it is threatened with the fate of the heath-hen—extinction.

In his "Biological Survey of Texas" Vernon Bailey (1905: 19)<sup>2</sup> places Attwater's prairie chicken at the head of the list of breeding birds of the Texas coastal prairie. In addition to being a characteristic bird of the region, this prairie chicken is probably the most popular species wherever found. Most people who know it have a genuine appreciation of its color and charm. Rare indeed is the person who finds no esthetic stimulus in the sight of a strutting male on the booming ground, or a brood of downy chicks on the edge of a short-grass flat. Both ranchmen and farmers highly appreciate the prairie chicken's appetite for grasshoppers, salt-marsh caterpillars (*Estigmene aceraca*), and the moths of the cotton leaf worm (*Alabama argillacea*). Under proper conditions prairie chicken hunting provides a high type of sport, and the flesh of the birds, especially that of the young, is highly esteemed as food.

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<sup>1</sup> Cooperative contribution from the Texas Cooperative Wildlife Research Unit, established by the Agricultural and Mechanical College of Texas; the Texas Game, Fish, and Oyster Commission; the American Wildlife Institute; and the Fish and Wildlife Service.

<sup>2</sup> Publications referred to parenthetically by date (alone or followed by colon and specific page) are listed in the Literature Cited, p. 62.

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### EXPLANATION OF FRONTISPIECE

Attwater's prairie chickens (*Tympanuchus cupido attwateri*) on booming ground

The real appeal of the prairie chicken, however, lies in its connection with the colorful and eventful early days in Texas. The prairie hen summons memories; it prompts old-timers to recall when the range was free of wire fences and oil derricks, and rich grasses grew waist high. Thoughtful people deplore the passing of Attwater's prairie chicken, one of the last landmarks of the prairie as it used to be. Highly appropriate was the selection of this bird as a species of major interest by the Texas Cooperative Wildlife Research unit.\*

#### FORMER DISTRIBUTION OF PRAIRIE CHICKENS IN TEXAS

H. C. Oberholser, in a letter to the present writer, states that in his opinion prairie chickens once occurred at some time of year on most prairie areas in Texas. In the main it appears that the different kinds of prairie chickens in the State occupied separate ranges, and that mixing and intergradation were confined largely to marginal areas.

The principal former range of the greater prairie chicken in Texas, as indicated by the records of F. M. Bailey (1927: 130), Gross (Bent 1932: 262), Strecker (1927: 321), and old residents with whom the writer has conferred, was northeastern Texas southwest to the vicinity of Waco. Likewise, records show that the lesser prairie chicken was indigenous to northwestern Texas and the high plains region in winter to about Bandera and westward through the "hill country" to the arid plains west of the Pecos River (Bendire 1892: 355, and others). Attwater's prairie chicken, it appears, was largely confined to the better-drained prairies of western Louisiana and Southeastern Texas (fig. 1, p. 3).

According to Oberholser (1938: 190-191) the eastern limit of the range of Attwater's prairie chicken was in the vicinity of Abbeville,

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\*So many persons have assisted in the prairie chicken studies that it is impossible to list them all. General supervision of the work was by Walter P. Taylor, leader of the Texas Cooperative Wildlife Research Unit, College Station, Tex. Valuable editorial suggestions were received from W. B. Davis, professor of wild game, School of Agriculture, Agricultural and Mechanical College of Texas; and from William J. Tucker, executive secretary, Texas Game, Fish, and Oyster Commission. The bulk of examinations of crops, gizzards, and scats was done by Clarence Cottam, Clarence F. Smith, and their associates in the Section of Food Habits, Division of Wildlife Research, Fish and Wildlife Service.

In his field work in 1938 the writer was assisted by H. R. Siegler, field biologist of the Research Unit. Many Colorado County landowners cooperated; among these, M. C. Shindler, Emil Gleuck, Ed Koy, Adolf Renz, and I. V. Duncan deserve special mention. E. P. Haddon, photographer of the Texas Commission, took some of the photographs here reproduced. The assistance of the State game wardens was indispensable. Deserving of special mention are T. S. Boothe, Beaumont; J. C. Gardner, Hull; R. Z. Cowart, Rosenberg; Ed McCloskey, Victoria; C. D. Tidwell, Bay City; G. P. Ferguson, Sinton; and T. T. Waddell, Eagle Lake. Waddell's contributions to the study were outstanding; he gave most generously of his time, records, and extensive experience. To him, and to all others, the writer is deeply grateful.

Opelousas, and Bayou Teche in Louisiana. There are no authentic records of the occurrence of any species of prairie chicken in Texas south of northern Aransas County, except for one bird reported from near Brownsville by Merrill (1879: 159-160). Prairie chickens did not occur near San Antonio, Tex., in 1890, for Babbitt, in Bendire (1894: 130) wrote as follows: "The prairie hen is not found in the



FIGURE 1.—Present distribution of Attwater's prairie chicken in Texas and probable former range in the coastal section.

immediate vicinity of San Antonio, Tex., but exists in great numbers south and southeast from here, all at an average distance of 100 miles. \* \* \* Simmons (1925: 82) submits the records of O. Brinkman and C. D. Oldright as evidence that Attwater's prairie chicken occurred as a breeding bird in the vicinity of Austin. Travis

County, and in Williamson County as late as 1878, but the accuracy of the data is questionable. Apparently the limit was the northern edge of the coastal prairie.

Roughly, the territory occupied by Attwater's prairie chicken was south of a line extending northeast from Refugio through Fannin, Thomaston, Provident City, Rock Island, Industry, Welcome, Bellville, Prairie View, Tom Ball, Humble, Liberty, Devers, Cheek, and Orange. All this area of approximately 8,500,000 acres in coastal Texas, however, was not occupied. Deciduous woodlands near rivers, as along the San Antonio, Guadalupe, Colorado, Brazos, and Trinity, were used only to a limited extent and only along the margins. Prairie chickens did not occupy the pine forests in Harris County and to the east or the thick mesquite-acacia brush that occurred in considerable stands in Calhoun and other western counties as much as 100 years ago. Brackish and salt-water marshes in Orange, Jefferson, and Chambers, and less widely in other counties to the west, and extensive cordgrass (*Spartina spartinae*) flats (pl. 2) in Aransas County and elsewhere in low country bordering the Gulf, probably always were little used by chickens except to a limited extent in winter. There were, however, about 6,000,000 acres of bluestem prairie that probably supported many prairie chickens in favorable years.

#### DIFFERENCES BETWEEN ATTWATER'S AND THE OTHER PRAIRIE CHICKENS

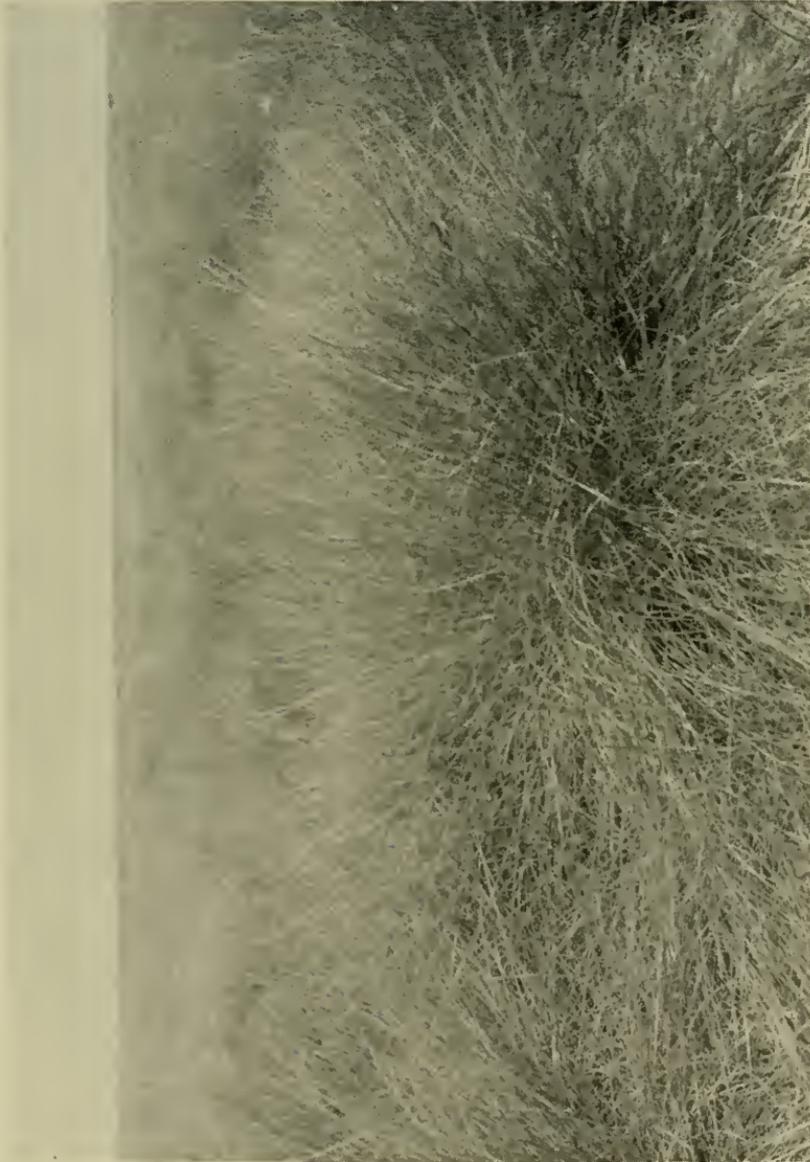
During the nineteenth century three kinds of prairie chickens occurred in Texas: the greater prairie chicken (*Tympanuchus cupido americanus* Reichenbach), Attwater's prairie chicken (*T. c. attwateri* Bendire), and the lesser prairie chicken (*T. pallidicinctus* Ridgway). Differences between the greater and Attwater's prairie chickens are slight; the lesser prairie chicken is somewhat better characterized.

#### ATTWATER'S PRAIRIE CHICKEN

Bendire (1894: 130) described Attwater's prairie chicken as—

Smaller than *T. americanus* [greater prairie chicken], darker in color, more tawny above, usually with more pronounced chestnut on the neck; smaller and more tawny light colored spots on the wing coverts, and much more scantily feathered tarsus, the latter never feathered down to the base of toes, even in front; a broad posterior strip of bare skin being always exposed, even in winter, while in summer much of the greater part of the tarsus is naked.

In weight Attwater's prairie chicken, however, is not perceptibly lighter than the greater prairie chicken. The average of 10 males (33.11 ounces, as shown in table 1, p. 5) exceeded by 2.11 ounces the average weight of the greater prairie chicken (31 ounces), as



Dense cordgrass areas are little used by Attwater's prairie chickens except to a limited extent in winter; Aransas County, Tex., 6 miles west of Austwell, August 28, 1938. (Photo by V. W. Lehmann.)



given by Gross (1930a: 40). The average weight of six females (25.7 ounces) was only 0.6 ounce less than that of the female greater prairie chicken (26.3 ounces), according to the same authority (loc. cit.). The weight of Attwater's prairie chickens, especially that of males, varies perceptibly from season to season; three males obtained at the beginning of the courtship season were appreciably heavier (about 7.5 ounces) than those collected at other times. Darkness of color, tawniness above, and the amount of chestnut on the neck are other characters that vary greatly both seasonally and individually. Winter specimens are generally lighter in color than those collected in spring; they have comparatively little chestnut on necks and backs. The feathering on the tarsus also varies with the season; the legs of specimens collected in winter are well feathered to the base of the toes. The style of barring on the back and rump, according to F. M. Bailey (1927: 130), is the same for both subspecies, that is, the bars are single, broad, and solid black. Altogether, physical differences between Attwater's and the greater prairie chicken are minor and insufficient to allow accurate field identification. In a series of skins, however, the smaller measurements of wing, tail, bill, and total length and the differences in general ruddiness and buffness of the underparts are characteristic and serve to separate Attwater's prairie chicken as a subspecies.

TABLE 1.—Weights of 16 Attwater's prairie chickens

County	Date collected	Weight <sup>1</sup>		County	Date collected	Weight <sup>1</sup>	
		Grams	Ounces			Grams	Ounces
<b>MALES</b>				<b>MALES</b>			
Colorado.....	Apr. 17, 1939 <sup>1</sup>	1,135.20	40.03	Refugio.....	Feb. 15, 1938	1,103.70	38.92
Do.....	Sept. 1, 1937 <sup>2</sup>	682.00	24.05	Do.....	do.....	1,125.20	39.68
Do.....	Sept. 4, 1937 <sup>3</sup>	590.07	20.81	Colorado.....	Mar. 18, 1938	1,120.45	39.51
Do.....	Oct. 23, 1937	760.20	26.81	Austin.....	Apr. 10, 1938 <sup>4</sup>	1,077.26	38.00
Do.....	Nov. 3, 1937	874.00	30.82	Colorado.....	July 26, 1938	921.34	32.50
<b>FEMALES</b>				<b>FEMALES</b>			
Colorado.....	Jan. 6, 1938	723.69	25.18	Refugio.....	Feb. 15, 1938	785.60	27.70
Do.....	Jan. 27, 1938	715.24	25.22	Colorado.....	Aug. 20, 1938	722.89	25.50
Austin.....	Feb. 14, 1938	726.80	25.63	Do.....	Aug. 23, 1938	708.72	25.00

<sup>1</sup> Average weights: Males, 938.94 gm. (33.11 oz.); females, 730.49 gm. (25.70 oz.).

<sup>2</sup> Taken from hawk.

<sup>3</sup> Immature bird.

<sup>4</sup> Taken from poacher.

#### LESSER PRAIRIE CHICKEN

The lesser prairie chicken is somewhat smaller than either of its relatives. Verne E. Davison, in a letter, reports that 20 mature males from Oklahoma weighed 23.50 to 31.50 ounces and averaged 27.56 ounces. Five hens weighed 23.75 to 27.50 ounces and averaged 25.55 ounces. In other words, these male lesser prairie chickens were, on the average, 3.44 ounces lighter than the male greater prairie chickens (31 ounces) weighed by Gross (1930a: 40); these female

lesser prairie chickens weighed 0.55 ounces less than the female greater prairie chickens that Gross obtained. According to Bailey (1927: 131), the general coloration of the lesser prairie chicken is paler than that of either the greater or Attwater's, and the color and arrangement of the bars on back and neck also differ. Whereas the bars are single, broad, and solid black in both the greater and Attwater's forms, they are treble, a broad brown bar enclosed by two narrow black ones, in the lesser species.

#### FORMER ABUNDANCE OF ATTWATER'S PRAIRIE CHICKEN

Accurate information as to the former abundance of Attwater's prairie chicken is difficult to obtain, although the data at hand record their numbers in certain areas. Many old cattlemen of the coastal prairie have told the writer that in early days the prairie chickens were relied upon to furnish fresh meat for the cattle camps. The task of killing 40 or 50 prairie chickens was menial, the cook of the outfit usually attending to it.

In the Eagle Lake area, Colorado County, not more than 35 years ago, prairie chickens were shot as clay pigeons are today. On appointed occasions parties of 10 to 20 or more men encamped in the sandhill country along the Bernard River and hunted the birds for periods varying from a few days to a week or more. At the end of each day the chickens killed, or their heads, were tallied. At the end of the encampment period the party having killed the smallest number paid the expenses of the outing. Waddell and others state that 10 or more piles of prairie chickens, each containing upwards of 100 birds, usually were left at the camp sites to rot or to be eaten by vultures. These encampments began about July 4 and continued through fall and winter.

During the summer of 1893 or 1894, in Matagorda County, near Bay City, V. L. LeTulle reports that 71 Attwater's prairie chickens were shot in 2 hours; and that in 1895, at the site of the present town of Van Vleck, he and 3 friends killed 72 birds in an afternoon, and except for poor marksmanship would have bagged many more. Near Wharton, in Wharton County, in the fall of 1894 or 1895, LeTulle found 340 piled where hunters had camped.

Mendell Burrell of the Ray Pipkin ranch (Big Hill country, Jefferson County) told the writer that as late as 1920 his domestic chickens were fed under the ranch house in winter to prevent prairie chickens from consuming the grain. In the same area it is said that flocks of from 150 to 200 Attwater's prairie chickens often alighted in the introduced chinaberry trees (*Melia azedarach umbraculifera*) around the ranch houses and fed extensively on the berries. In verification of this statement W. S. Boothe, State game warden at

Beaumont, Tex., presented the writer with a photograph, taken in 1910 on the White Ranch at Devers, showing a dozen prairie chickens in a chinaberry tree beside a house.

C. H. Brosig, who hunted Attwater's prairie chickens in the Eagle Lake area for more than 40 years, reported that the birds once were so numerous in the sandhill country bordering the Bernard River that a new covey frequently was flushed while singles from one previously discovered were being pursued. Paul Mundelius noted a similar high density in concentrations of prairie chickens in the Sealy-San Felipe section in the eastern part of Austin County in 1873-75. These conditions are seldom found on areas where the population is less than one bird to an acre, and they show the former abundance of Attwater's prairie chickens in favorable areas. Not all the coastal bluestem (*Andropogon*) prairie, about 6,000,000 acres, was equally favorable for prairie chickens even under pristine conditions; well-drained, well-populated country (one bird to an acre), as along the Bernard River, did not aggregate more than 900,000 acres, or about 15 percent of the inhabited range. A little more than half, 3,300,000 acres, or 55 percent, of the prairie country was only fairly well drained; these areas, protected for periods up to 17 years, now have a maximum population of about one bird to each 10 acres. Approximately 1,800,000 acres, or 30 percent, was poorly drained; prohibition of hunting for periods up to 15 years has not produced a population in excess of one bird to each 50 acres on certain of these large ranches. Probably, therefore, the former abundance of Attwater's prairie chicken in Texas approached, but seldom if ever attained or exceeded, 1,000,000 individuals, even in peak years.

#### PRESENT DISTRIBUTION AND NUMBERS

Data on the present status of Attwater's prairie chicken (table 2, p. 8) were obtained as follows:

At least 90 percent of all farms and ranches known or thought to have been occupied by the birds in 1937 were visited by the writer in company with local State game wardens. Unless the warden was thoroughly familiar with conditions on the various areas, conferences were held with landowners, managers, cowboys, guides, hunters, or other persons who were in position to know the status of prairie chickens on particular tracts. After the conferences a general reconnaissance of the areas was made by automobile or on horseback, and notes were taken on the topography, vegetation, surface water, and soil to ascertain the general suitability of the land for prairie chickens, as was done in similar studies previously made in the Eagle Lake area.

Then in the light of all available information the range of Attwater's prairie chicken was mapped in each county, and representa-

tive sample areas were selected for intensive study. The birds were then "rope counted"<sup>4</sup> on the sample tracts. Finally, the total population of the area was estimated from the data obtained by counting the sample plots.

TABLE 2.—Population status of the Attwater's prairie chicken in Texas (1937)

County	Size of tract	Census area		Territory occupied per bird		Population of whole tract
		Size	Population (rope count)	Census area	Whole tract	
	Acres	Acres	Number	Acres	Acres	Number
Arañas <sup>1</sup> .....	-----	1,080	56	19.2	-----	-----
Refugio.....	-----	530	106	5.0	-----	-----
Total or average (1) <sup>2</sup> .....	42,000	1,610	162	-----	9.9	4,242
Calhoun <sup>1</sup> .....	6,554	-----	-----	-----	-----	<sup>2</sup> 25
Goliad <sup>1</sup> .....	5,000	-----	-----	-----	-----	<sup>3</sup> 4
Total or average (2).....	11,554	-----	-----	-----	-----	-----
Dewitt <sup>1</sup> .....	-----	-----	-----	-----	-----	-----
Victoria.....	-----	230	4	57.5	-----	-----
-----	-----	873	14	62.3	-----	-----
-----	-----	218	0	-----	-----	-----
Total or average (3).....	65,535	1,321	18	-----	73.4	892
Wharton <sup>1</sup> .....	4,000	-----	-----	-----	-----	-----
Lavaca <sup>1</sup> .....	4,915	-----	-----	-----	-----	-----
Austin.....	18,022	4,200	32	131.2	-----	-----
Colorado.....	49,152	14,250	315	45.2	-----	-----
Total or average (4).....	76,089	18,450	347	-----	53.1	1,433
Jackson <sup>1</sup> .....	-----	-----	-----	-----	-----	-----
Matagorda.....	-----	736	0	-----	-----	-----
Total or average (5).....	12,288	736	0	-----	-----	<sup>2</sup> 50
Harris.....	-----	542	4	135.5	-----	-----
-----	-----	364	0	-----	-----	-----
-----	-----	219	1	219.0	-----	-----
-----	-----	157	3	52.3	-----	-----
Waller.....	-----	716	0	-----	-----	-----
Fort Bend.....	-----	482	0	-----	-----	-----
Total or average (6).....	103,878	2,480	8	-----	310.0	335
Brazoria.....	-----	585	29	20.1	-----	-----
-----	-----	248	2	124.0	-----	-----
-----	-----	269	1	269.0	-----	-----
-----	-----	334	2	167.0	-----	-----
Galveston <sup>1</sup> .....	-----	-----	-----	-----	-----	-----
Total or average (7).....	54,067	1,436	34	-----	42.2	1,231
Jefferson.....	-----	4,000	24	166.6	-----	-----
Chambers.....	-----	700	1	700.0	-----	-----
Liberty.....	-----	400	0	-----	-----	-----
Total or average (8).....	91,724	5,100	25	-----	204.0	449
Grand total or average.....	457,135	31,133	594	-----	52.4	8,711

<sup>1</sup> Counties in which prairie chickens occur but in which counts were not made because of scarcity of birds or similarity of the areas to adjoining counties.

<sup>2</sup> Numbers in parentheses in total lines refer to areas correspondingly numbered in the map, fig. 1, p. 3.

<sup>3</sup> Estimates supplied by game wardens.

<sup>4</sup> For an account of the method used in rope counting see p. 49.

The known range of Attwater's prairie chicken in Texas, as of September 1937, aggregated only 457,135 acres, as compared with approximately 6,000,000 acres in former times. The range has therefore been reduced more than 93 percent during the past 100 years or so. The birds are still to be found in the counties of Aransas, Refugio, Goliad, Victoria, Calhoun, Dewitt, Jefferson, Waller, Galveston, Chambers, Liberty, Lavaca, Wharton, Colorado, Matagorda, Austin, Fort Bend, Harris, Brazoria, and possibly Jackson and Orange, although they have not been reported by reliable observers in the last two for several years. They have definitely been extirpated from Willacy and Montgomery Counties, and their distribution has become restricted throughout the State, especially in the counties of Goliad, DeWitt, Lavaca, Calhoun, Matagorda, Galveston, Fort Bend, Liberty, Jackson, and Orange, if they occur there at all. Prairie chickens had not been seen in Goliad County for at least 10 years prior to 1937, at which time four birds were reported on the W. J. O'Conner ranch.

No more than half the grassland range in any county except Refugio is occupied by prairie chickens. In the counties of Matagorda, Lavaca, Wharton, Calhoun, Liberty, Jackson, and Fort Bend even less than 10 percent of apparently satisfactory pasture is inhabited. Roughly, the available range for prairie chickens is only about 30 percent occupied and, with the exception of about 20,000 acres in southeastern Refugio County, all the occupied area has a sparse population.

The total number of prairie chickens in coastal Texas in the summer of 1937 was only about 8,700. The estimated 1937 population was probably less than 1 percent of the number believed to have occupied the coastal prairie in peak years before it was developed by white men. Approximately 4,200 chickens (or almost 50 percent of the known population of the State) inhabit two ranches in Refugio and Aransas Counties. The estimated population of 4,500 birds for the remainder of Texas is small indeed!

The consensus is that, during the past 10 years, the number of prairie chickens has decreased in all coastal counties except Refugio and Brazoria. In Refugio County there has been a rapid increase in recent years, probably largely because of excellent protection on the Salt Creek and Martin O'Conner ranches. Since 1935 the birds have spread from these onto the O'Brien, Powers, Welder, and Heard ranches near Greta, Refugio County, and probably also into Goliad County. Because of protection during a 5-year close season in Brazoria County (1932-36), R. Z. Cowart, State game warden there believes that in 1937 the number of birds had reached and possibly slightly exceeded the 1927 population level.

The prairie chicken population of the counties of Orange, Liberty, Fort Bend, Matagorda, Jackson, Lavaca, Calhoun, and Goliad, where populations of less than 100 birds per county obtain, may already be reduced to the point where recovery will be extremely difficult or even impossible. So long as any birds remain, however, every effort should be made to build up their numbers.

## HABITS

### COURTSHIP AND MATING

Prairie chickens do not pair for breeding, but are promiscuous. Males occupy selected courtship stations on booming grounds (see frontispiece), which are visited by the females. Copulation may take place elsewhere, however, in case of chance meetings. To attract the females, the cocks put on elaborate exhibitions, and their courtship antics are unbelievably weird. Of special interest is the manner in which the booming call is rendered.

This call of the male resembles somewhat the sound *whur-ru-rrr*, with strong accent on the second syllable. Although it generally lasts about 5 seconds, the call varies in length and tone. In mid-season the calls are characteristically deep and full-throated; later they become shorter and higher pitched, possibly because the males are then less vigorous. The sound of the booming carries for a mile or more on quiet days. It has a ventriloquial effect and often seems farther away or closer than it actually is. During the courtship season males boom regularly in early morning (sunrise until about 8 a. m.) and in late afternoon (5:30 p. m. until sunset), but calls have been heard at all hours of the day and night. Booming at night is sporadic, however, even during the peak of the courtship season in March, being most common when the moon is bright and when there is little wind.

The appearance of the male, while booming, is striking. As a preliminary to uttering the call he stretches his neck forward parallel to the ground. The erected pinnae, or neck tufts, point forward; the spread tail is held vertically or even inclined slightly over the back. The wings are extended downward and held firmly against the body and legs, the primaries almost touching the ground. The whole body appears strained and rigid. A short run forward is followed by vigorous stamping with the feet, which lasts only a few moments, but which under favorable conditions is distinctly audible for 50 feet or more. Inflation of the air sacs, which are actually but one sac with two lateral portions (pl. 3) is synchronized with the stamping. The first syllable of the booming is given before stamping ends, the male quickly jerking his head downward as he begins the call and keeping it there until the air sac is deflated.



BB188M

Male Attwater's prairie chicken, showing vocal sacs. (Photo from Texas Game, Fish, and Oyster Commission.)



The call of Attwater's prairie chicken apparently is given in the same manner as was that of the extinct heath-hen, its near relative. Gross (Bent 1932: 272) describes the booming mechanism of the heath-hen as follows:

The sacs do not produce the notes, as was thought by some of the earlier ornithologists, but have much to do with modifying the sounds produced by the syrinx (the vocal mechanism at the juncture of the bronchial tubes). The sounds are produced by the air forced from the lungs, which vibrate specialized membranes of the syrinx under control of a complex set of muscles. The sound waves then issue through the trachea and glottis to the pharynx. In the production of such notes as the ordinary cackle the mandibles are opened and the air accompanied by the sound waves issues out of the mouth. In the tooting [booming] performance the mandibles are tightly closed, the throat patch is elevated, and the tongue is forced against the roof of the mouth (palate) by the mylohyoides muscles, which close off the exit through the internal nares. The tongue is bent in such a way that it causes the glottis at the base of the tongue to open directly in front of the esophagus. The air now coming from the respiratory system is forced to fill the modified anterior end of the esophagus, or gullet, which becomes distended like a balloon. While the air sac is filling, the sound waves produced by the syrinx beat against these tense drumlike membranes, which serve as resonators for the sounds and give them their great carrying power.

The booming call does not complete the vocabulary of male prairie chickens at courtship time. The rendition of additional calls, all distinctly henlike, is described as closely as possible on p. 12. On windy days cackling sounds, like Nos. 1, 2, and 3 in the list, carry farther than booming. The call note *pwoik* (No. 14) dominates when hens visit the courtship grounds. Observers may identify grounds where females are present by this *pwoik* call.

Males do not confine their courtship activities to vocalizing, and fights are common. Opponents usually approach each other, uttering peculiar whining notes, with necks outstretched, ear tufts erected, tails spread, wings drooped, and air sacs deflated. Then, as if possessed of the same thought, they suddenly hop off the ground, wings beating rapidly, and clash in midair. These bouts are usually discontinued after three or four flurries, and the victors seem satisfied after pursuing their opponents for short distances. Many feathers are frequently lost, but fights seldom if ever end fatally. Males sometimes engage fancied opponents, as clumps of weeds or tufts of tall grass, and at other times they joust and bluff for periods up to 30 minutes or more without striking a blow. With necks outstretched, heads held a few inches apart, and wings dangling loosely, they resemble domestic roosters fighting. At intervals males flutter into the air to heights of 3 to 5 feet, alighting nearly on the spot whence they arose. Their surplus energy apparently must be expended

in one way or another, although activity sometimes lags for brief periods.

## CALL OF MALE PRAIRIE CHICKENS ON COURTSHIP GROUNDS

1. *Ca-ca'-ca-ca-ca-ca-ca-ca-cao-cao*--- All except last two notes given rapidly.
2. *Ca-ca'-cao, ca-ca'-cao*----- Rapid.
3. *Ca-ca-ca-ca'-ca*----- Rapid, accent on second to last syllable.
4. *Ca-ca-ca-ca-keeee*----- All except last syllable given rapidly.
5. *Kwieee, ca-ca-ca-ca-ca-ca*----- First syllable drawn out, remainder given rapidly.
6. *Kwerr-kwerr-pwah*----- First two syllables drawn out.
7. *Kwier-kwier-kwier-kwier*----- All syllables drawn out.
8. *Pwark* or *pwarrk*----- Medium rapid. Often precedes cackling or booming, carries as far as or farther than booming notes under certain weather conditions.
9. *Caaa-caaa-caaa-caaaa*----- Slow and drawn out. Sounds almost exactly like protests of a domestic setting hen that is disturbed.
10. *Pwiek, pwark*----- Medium rapid.
11. *Pwiek, pwiek, pwiek*----- All notes drawn out with emphasis on the *iek*.
12. *Pwiek, ca-ca-ca-ca-ca-ca*----- Pause after first note, cackle given rapidly.
13. *Pwk-pwk-pwk-pwk-pwk-pwk*----- Harsh notes executed rapidly, but in a subdued tone.
14. *Pwoik, pwoik, pwoik, pwoik*----- Executed rapidly and with much vigor. These notes predominate all other calls when a female approaches a courtship ground.
15. *Kliee, kliee, kliee; ca-ca-ca-ca*--- *Kliee's* drawn out; *ca's* given rapidly. This is a prominent call in early spring.
16. *Kwoo, kwoo; kwah, kwah*----- Rapid. Another prominent early season call.

The performers do considerable feeding when they first arrive on the courtship ground, and certain of them feed sporadically throughout their stay. At other times individuals, sometimes an entire group, sit or stand in their places and look about. Rest periods terminate abruptly, however, when a male recognizes a real or fancied challenge, or when a hen appears.

While the male is bold and noisy during the mating season, the female is demure and shy. Hens visit the courtship grounds irregularly except early in March. Even in well-populated territory a week sometimes elapses before the persistent male performers are rewarded by female company. When on or near a drumming ground, hens usually appear little interested in the spirited antics of the obviously excited males. Sometimes, however, they walk among the contestants and mate with one or several of them. Hens usually remain at the courtship areas briefly; usually they stay only a few minutes before leaving to feed elsewhere or fly to the vicinity of their nests.

In Colorado County signs of the approaching breeding season were noted early in January (1937) and late in December (1938) when certain males, probably the most vigorous, pecked at and otherwise bullied their fellows as the flocks left the roost or fed early each morning. A few weeks later, early in February (1937), and late in January (1938), males assembled early in the morning on short-grass areas that later served as courtship grounds, and fought and maneuvered for choice positions. For a week or more, calls consisted largely of miscellaneous squawks and cackles, and fights, though frequent, were of short duration. Males occasionally attempted to drum or boom, but their notes lacked midseason depth and vigor. Females, still in winter flocks, seemed indifferent to the proceedings. It was not until February 12, in 1937, and January 26, in 1938, that booming was commonly heard, and each year, after 2 to 3 weeks, flocks of females generally broke up and the courtship season was well under way. During both 1937 and 1938 courtship activity was at its peak in March, continuing through April and ending on May 20, in 1937, and on May 21, in 1938, when the last booming calls were heard.

Key areas during the courtship season are the booming grounds where males assemble each morning from daybreak until about 8 a. m. and each afternoon from 5:30 p. m. until dark and give their courtship display.

The preferred booming ground is a short-grass flat, an acre or so in extent, surrounded by an area of medium to heavy grassy cover suitable for nesting. Of several hundred sites observed during 3 years (1936-38) only one was on ground elevated enough to be termed a small knoll. The others were even with or slightly below the adjacent land surface. Stoddard (Bent 1932: 245), discussing the greater prairie chicken in Wisconsin, says that "the 'cooing' ground [courtship ground] at the sandy west end of Sauk Prairie has been used each spring for over 30 years, the birds always using the same knoll whether in rye, stubble, or grown to grass." Courtship grounds of Attwater's prairie chicken do not show the same degree of permanence. Cultivation seemingly results in immediate eviction, whether the crop is rice, corn, cotton, or something else. Likewise, the birds do not use fallow fields except where cultivated land is the only other environmental type available, or where the fallow land has aged to the extent that its surface and vegetation are nearly identical with that of nearby grassland. Even those courtship grounds that are in pastures may or may not be occupied each year for a series of years. Of 10 such grounds, on which records were obtained from 1936 through 1938, only 5, or 50 percent, were occupied each year. Their populations were fairly stable (see table 3, p. 14). Of the others, 2 were occupied in 1936 and 1937; 2 were unused except in 1936; and 1 was occupied in 1936, in part of 1937, and throughout the entire season in 1938. There was little variation in the prairie chicken

population of the pastures in which these courtship grounds were situated, but in every instance the vegetation on or near the study areas varied in density through grazing or burning. Cover changes on and near courtship areas influenced their attractiveness to the birds, possibly to the point of determining whether they would be occupied and by how many individuals.

TABLE 3.—Occurrences in 3 years of male prairie chickens on 5 courtship grounds in Colorado County

Name of pasture	Observations			Birds observed					
				Extremes			Averages		
	1936	1937	1938	1936	1937	1938	1936	1937	1938
Thomas.....	2	11	6	7-9	6-9	4-11	8.0	7.0	8.0
Do.....	2	8	6	9-11	3-10	5-8	10.0	6.0	7.0
Do.....	2	14	6	5-6	3-9	3-8	5.5	8.0	7.0
Duncan.....	2	13	11	6-8	5-11	5-13	7.0	9.0	10.0
Everett.....	2	20	12	7-7	0-8	6-14	7.0	6.0	10.0
Total or average.....	10	66	42	-----	-----	-----	7.5	7.2	8.4

#### NESTING

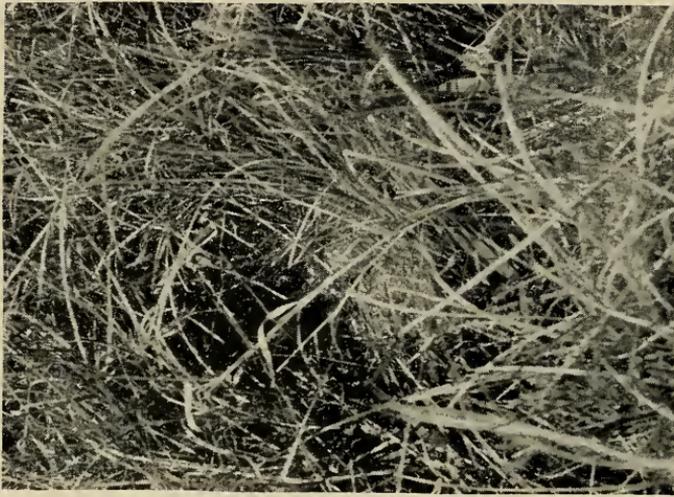
While the males are still engaged in their courtship performances, the females quietly select and improve the nest sites and attend to laying, incubating, and hatching the eggs and rearing the young. Nests (pl. 4) are made on the ground. Of 19 examined in 1937 and 1938, 17 were in long-grass pastures, 1 in a hay meadow, and 1 in a fallow field. All were in dead grass of the previous year's growth. Fifteen (about 76 percent) were on or near well-drained mounds or ridges, and 4 were in poorly drained situations. In a choice of nest sites, cover appeared of more importance than topography and the structure of the soil. Twelve (63 percent) of the study nests were situated within 10 yards of well-marked trails, possibly because prairie chickens dislike walking through heavy matted vegetation when approaching or leaving their nests. Cattle make many trails, thereby improving nesting areas.

Study nests were found always within a radius of half a mile to a mile from occupied booming grounds. Sometimes the sites were rather distant from acceptable feeding territory, although flights of up to a mile seemed to inconvenience the birds very little.

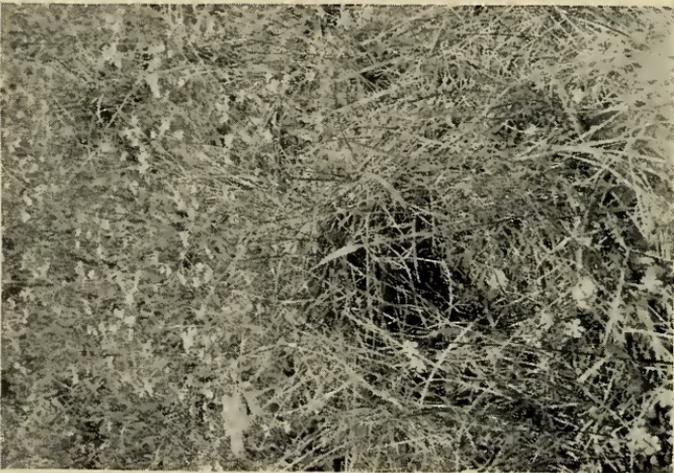
Nests were merely shallow depressions, about 7 inches in diameter, lined with bits of dead grass, twigs, and a few feathers, presumably from the females. All were more or less roofed over because of the lapping or bending over of surrounding vegetation. Entrances faced in various directions with no preference shown. There was considerable variation in degree of concealment (pl. 5), at least according to human standards; 5 nests being excellently, 10 well, and 4 poorly, concealed. Rapid new plant growth in April and May aided ma-



Nest and eggs of Attwater's prairie chicken; Colorado County, Tex., 5½ miles north of Eagle Lake, April 1938. (Photo from Texas Game, Fish, and Oyster Commission; E. P. Haddon.)



B49500; B49502; B49664



*Left*, Poorly concealed nest, eggs eaten by predator (shell fragments at entrance); Winterman pasture, Colorado County, Tex., April 1937. *Middle*, Nest fairly well concealed; Sklar Marcella pasture, Colorado County, May 1937. *Right*, Well-concealed nest; Colorado County, 8 miles northeast of Eagle Lake, April 10, 1937. (Photos by V. W. Lehmann.)

terially in hiding nests; consequently, some nests that were relatively exposed when found were well hidden later. Wild indigo (*Baptisia* sp.), vetch (*Vicia ludoviciana*), phlox (*Phlox drummondii*), perennial ragweed (*Ambrosia psilostachya*), dogfennel (*Eupatorium* sp.), and panic grass (*Panicum* sp.) were green plants that aided concealment materially by mid-May. In Colorado County, favorite nesting materials were dry bluestem grass (*Andropogon scoparius*), and paspalum (*Paspalum dilatatum*).

The earliest date for a nest containing eggs was reported by Waddell near Egypt, Wharton County, February 25, 1925; the latest record is that of a nest in Colorado County in which the clutch was completed May 29, 1938. In both 1937 and 1938, however, the peak of the laying season in Colorado County was late March and early April. Hens always laid in the morning, usually from 7:30 to 9, flying to the vicinity of their nests when ready. After cautiously looking about or feeding a bit longer, hens walked to the nests and remained there for from about 20 minutes to an hour. The laying completed, they regularly walked about 20 feet from the nest, scanned the landscape, and flew away. Since incomplete clutches were unguarded except during about an hour each day, they were especially vulnerable to natural enemies.

Hens under observation normally laid an egg a day until the clutch of 8 to 15 was complete, but sometimes they failed to lay for periods of 1 to 3 days. Clutches usually contained 12 eggs, and laying was generally completed in about 2 weeks. The period of egg laying was sometimes extended, however, when nests were destroyed. Three hens, each the only resident on a small unburned plot, re-nested during 1937, one of them three times.

New nests, however, were placed 5 to 20 yards from old ones, and were less effectively concealed. Destructive agents had even greater opportunities to take the later nests, as they did in four out of five cases. Since booming ended by mid-May, the period for mating was short. Late broods were invariably smaller than early ones, probably because late clutches were small, their hatchability low, or their mortality heavy. A successful season depends largely on the fate of early nests, so that a primary objective of management should be to safeguard these attempts.

Twenty-nine eggs of Attwater's prairie chicken measured by Bent (1932: 264) averaged 42.3 by 31.5 millimeters in size, showing extremes of 44.9 by 32, 42.4 by 33.5, 38.8 by 28.9, and 39.8 by 28.6 millimeters. Newly laid eggs were dull cream or bluish buff in color, some of them minutely specked with red. During incubation the color of the eggs became dull and the shells shiny. Incubation began at from 1 day before until 4 days after the last egg was laid.

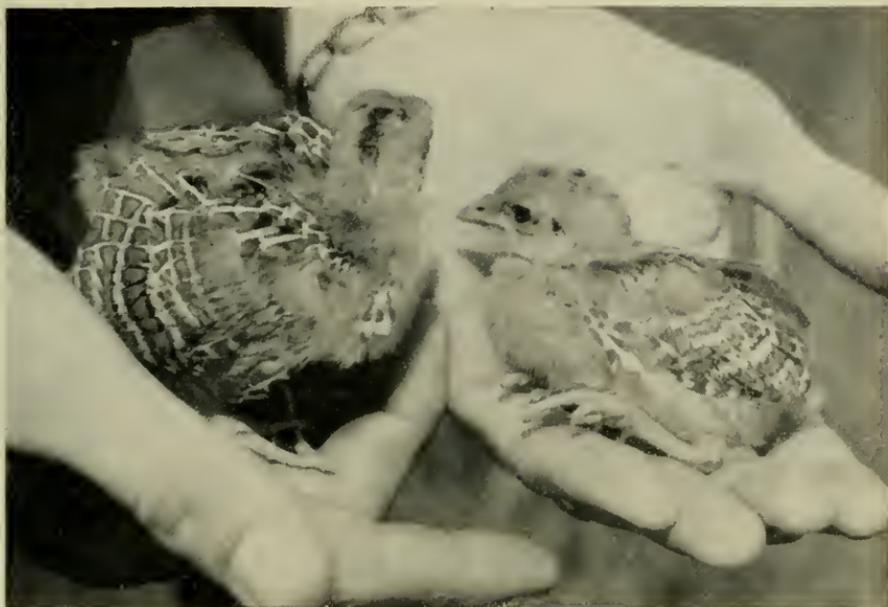
Except for two feeding and resting periods daily, extending from about 7 to 8 a. m. and from 5:30 to 6:30 p. m., hens incubated constantly. When incubation was advanced, morning feeding was frequently dispensed with. Two clutches pipped approximately 23 and 24 days after setting began, in each instance requiring about 48 hours longer to hatch. Of 71 eggs in 7 nests, only 3 (about 4 percent) were infertile, 66 hatching successfully. Seemingly, fertility and hatchability are high under favorable conditions.

The hatching period was evidently a time of danger. Chicks peeped incessantly and scrambled in and out of the nest. Nests emitted strong odors, apparent even to man. Females at hatching time appeared nervous and shifted their positions frequently. Unless disturbed, however, they did not leave until the last egg had hatched, after which they deserted the nests. In 1937 a nest in which all young were hatched by 11:50 a. m. on May 15 was vacated by 3 p. m. that day, and a brood that was hatching at 8:30 a. m. on June 2 was gone 24 hours later. One hen left before 2 pipped eggs were hatched and before the natal down on some of the young was dry, probably because fire ants (*Solenopsis*) had entered the nest.

#### GROWTH AND DEVELOPMENT OF YOUNG

When leading chicks from the nest, old birds traveled through the lightest cover or followed trails, probably because heavy matted vegetation impeded progress and increased the chance of chicks getting lost. Cow trails were favorite travel ways. Chicks ranged in front, behind, and on both sides of the hen over an area 1 to 5 yards in radius. Interruptions for sporadic feeding and for frequent brooding, which was probably more necessary for assembling than for warming the young, made progress slow. Hens with chicks less than 10 days old (pl. 6) seemed mainly concerned with watchfulness and brooding. Occasionally they caught available insects or nipped off a few green leaves or buds, but they did little continuous feeding. When danger threatened, they gave a warning call, best described as a low *kwerr*, *kwerr*, *kwerr*, and slowly skulked through the grass with head lowered and wings dangling loosely, almost touching the sod. Young birds "froze" with their bodies closely pressed to the ground. Decoy efforts of adult females were never so energetic as those of bobwhites under similar circumstances. When hens were flushed, the chicks in hiding (pl. 6) became impatient after 3 to 5 minutes, and peeped and ran about in spite of the fact that the object of suspicion remained. After the immature birds of 2 to 3 weeks of age could fly fairly well, females accompanying them did not decoy, but always flushed freely, the young doing likewise.

Chicks that were less than a week old were brooded quite often, probably in all for about 50 percent of the daylight period. Ten birds



*Above*, Chicks about 10 days old; Colorado County, Tex., approximately 6 miles north of Eagle Lake, May 3, 1938. *Below*, Chicks hiding; Colorado County, Tex., approximately 6½ miles north of Eagle Lake, May 3, 1938. (Photos from Texas Game, Fish, and Oyster Commission; E. P. Haddon.)



about 2 days old were brooded 42 minutes out of the 1½ hours during which they were watched on May 4, 1937. Their position during brooding was interesting. Hens squatted low with legs at an angle of about 30 degrees with the ground. Wings were drooped and feathers of the underparts were ruffled. Some chicks scrambled up and under the wings. When the brooding hens were frightened and suddenly stood erect, usually only two or three chicks were visible; the others, however, tumbled from beneath her wings a few moments later. As the chicks grew older, the time spent brooding diminished; those 2 weeks old apparently were brooded little except early in the morning, during inclement weather, and at night.

Newly hatched chicks are about the size of day-old bantams, and their coloration is nearly identical with that of young bronze turkeys. The basic, buffy yellow is streaked with gray on head and upperparts. Growth and development are rapid. Wing feathers appear almost at once; week-old chicks have primaries approximately five-eighths of an inch long. Chicks fly when 2 weeks old. Except for differences in the length of the tail and legs, they are about the size of English sparrows. When 3 weeks of age, youngsters are almost as large as starlings and can make sustained flights of 40 yards or more. At 4 or 5 weeks, young birds approximate the size of mature bobwhites, and often fly a hundred yards before alighting. When 6 or 7 weeks old, the young are about half grown and at 8 or 9 weeks they are three-fourths the size of adults. Youngsters 10 to 12 weeks old can scarcely be differentiated from the old birds in the field. Weight evidently does not increase as rapidly as size, however, for two birds approximately 3 months old were more than a pound lighter than mature individuals.

As young prairie chickens grow in size, all cannot, of course, maintain a brooding position under the sheltering body of the mother. Usually by the time they are about 3 weeks old some are forced outside; there they sleep with bodies pressed closely to that of the hen. When 4 to 5 weeks of age, two or three chicks sometimes crowd under their mother, but the remainder roost from a few inches to about 2 feet away. At 6 to 7 weeks, young birds adopt the roosting formation of adults. Flocks of Attwater's prairie chickens sleep about a foot or so apart, the individuals facing in different directions. Roosting spots vary in size from 1 to 3 square yards or more, depending on the number of birds in the group. The number of seats left at a roosting site is not an absolutely accurate index to the number of birds in a flock, because slight shifting of individuals during the night brings about the deposition of more than one pile by a bird.

Chicks about 2 weeks old take vigorous dust baths, a habit that is indulged in regularly throughout life when dry, powdery material is

available. Prairie chickens generally dust during the midday rest period that extends from about 10 a. m. to 4 p. m. Old pocket gopher mounds and cattle wallows are favorite places. Some birds use the same dust bath more than once.

## BROOD SIZE

The size of the brood generally decreases with the age of the young. Of 48 broods on which accurate counts were kept (table 4, below) 6 from 1 to 3 days old contained 64 young, averaging 10.6 birds each. Three broods estimated to be 5 to 10 days old contained only 14 chicks averaging 4.6 each. Four broods 15 to 27 days old had 22 young, or an average of 5.5. Fifteen families over 4 and under 6 weeks of age aggregated 80 young and averaged 5.3. Twenty groups over 6 weeks totaled 80 young and averaged 4 each. The average size (5.3 young) of 15 families, estimated to be over 4 but under 6 weeks of age, was exactly half the average size (10.6) of 6 new broods. The average size (5.3) of 15 families over 4 but under 6 weeks old was but slightly larger than the average size (4.0) of 20 families older than 6 weeks. Therefore, it appears that juvenile mortality is heaviest during the first 4 weeks and comparatively light thereafter.

TABLE 4.—Size of broods and number of chicks counted during May, June, and July

County	Date	Family groups observed	Chicks per group	Chicks per average group
Colorado	May 4	1	10	10.00
Do	May 15	1	12	12.00
Do	May 18	1	12	12.00
Do	May 23	3	2, 4, 2	2.66
Do	May 28	3	7, 9, 11	9.00
Do	May 29	1	8	8.00
Do	May 31	2	4, 8	6.00
Total or average for May		12	89	7.41
Colorado	June 2	4	6, 9, 4, 2	6.33
Do	June 3	1	10	10.00
Do	June 8	2	3, 3	3.00
Do	June 10	2	4, 8	6.00
Jefferson	June 24	3	5, 4, 3	4.00
Total or average for June		12	61	5.08
Brazoria	July 1	3	5, 5, 6	5.33
Colorado	July 8	2	3, 3	3.00
Victoria	July 14	1	7	7.00
Refugio	July 17	4	10, 8, 1, 3	6.00
Do	July 19	6	10, 2, 2, 4, 5, 2	4.16
Colorado	July 26	2	10, 5	8.00
Total or average for July		18	92	5.11
Harris	Aug. 12	1	3	3.00
Colorado	Sept. 2	3	5, 3, 3	3.66
Do	Sept. 3	1	3	3.00
Do	Sept. 4	1	4	4.00
Total or average for August, September		5	18	3.60
Grand total or average		48	263	5.48

## JUVENILE MORTALITY

Although much remains to be learned about juvenile mortality, its causes were fairly well established in some instances. Chicks are sometimes trapped and drowned in rice fields at the time of flooding (usually about May 10). In 1925, near Egypt, Wharton County, Waddell and others picked up hatfuls of chicks and carried them beyond the levees. In 1937 a farmer near Eagle Lake similarly rescued a brood. The number of chicks annually saved from this hazard, however, is probably insignificant in contrast to those lost. Prairie fires kill young and, as stated on page 42, burning is still common in certain areas at nesting and brooding time. Unfavorable weather, especially rains (pp. 32 to 35) and natural enemies (p. 39), account for the death of some young birds, but no small percentage of these may be chicks that are lost.

Chicks stray from the brood more often than one might suspect. During April, May, and June, 1937, no fewer than 13 strays were seen, all under 4 weeks old. Usually they occurred as singles, but sometimes in pairs and trios. How the youngsters became lost, of course, was usually unknown, but several reasons were apparent. The characteristic loose feeding formation of broods possibly contributed to straying; also, broods usually scattered widely and flew far when disturbed; and, possibly most significant of all, adults did not appear to have a highly developed rallying call that doubtless would be of assistance in reassembling youngsters.

Lost chicks evidently join other groups occasionally, as hens accompanied by young of varied sizes were several times noted in 1937. Once two chicks, about 2 and 3 weeks old, respectively, were seen with two molting males. Higher population levels might increase the frequency of adoptions.

## FAMILY DISINTEGRATION

Many young Attwater's prairie chickens 6 to 8 weeks old leave the family groups and take up life on their own, but, as is true with domestic chickens, all young do not leave the hen at the same time; disintegration of the family group is gradual. Some young remain with the hen well into the fall. Unattached young, 6 weeks of age or older, as distinguished from lost chicks less than a month old, became noticeable late in June and they were frequently seen after July. Family disintegration after 6 weeks or thereabouts is normal. Young prairie chickens at that age seem as capable of foraging and resisting adverse weather as are the adults.

## ANNUAL INCREASE

The actual survival of young prairie chickens (table 5, below) probably is always well below the potential yield (12 or so young from each hen) even when favorable weather conditions obtain during the critical breeding season.

TABLE 5.—*Young and adult birds observed in census after June 30, 1937*

County	Date	Area	Adults				Young		Total
			Males	Females	Sex unknown	Total	Families	Strays	
		<i>Acres</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>
Brazoria.....	July 1	585	2	4	2	8	5, 5, 6	1, 1, 1, 1, 1	21
Victoria.....	July 14	921	1	1	6	8	7	1, 1, 2	10
Refugio.....	July 17	1, 080	1	4	23	28	10, 8, 1, 3	2, 1, 1, 1, 1	28
Do.....	July 19	530	3	8	53	64	10, 2, 2, 4, 5, 1	1, 1, 2, 1, 1, 1	32
Colorado.....	July 26	1, 450	0	2	4	6	11, 5	2, 3	21
Brazoria.....	July 27	851	2	0	2	4	3	1	4
Harris.....	Aug. 12	1, 282	1	1	2	4	3	1	4
Colorado.....	Sept. 1	2, 000	1	5	8	14	5, 3, 3	1, 2, 1, 3	18
Total.....		8, 699	11	25	100	136	103	35	138

In a rope count on or after July 1, 1937, 138 young as compared with 136 adults (about 1:1) were enumerated on an area of more than 8,699 acres. At this time most of the counted birds were 4 weeks old or more and were beyond the age when mortality is thought to be most severe. The increase on the counted areas, then, was only about 100 percent in spite of the fact that food, cover, and weather conditions were favorable. A 100 percent increase of prairie chickens in any one year is very good, and the arguments for long open seasons and large bag limits, based on the potential annual increase (12 chicks for each hen, or about 600 percent a year), evidently are fallacious.

## FLOCKING

Late in summer and early in fall, the prairie chickens displayed no marked tendency to combine into stable groups. In August and September of 1936 and 1937 well over half the birds observed in Colorado County were recorded as singles, pairs, and trios, although small groups of 4 to 6 were not uncommon. Occasional larger flocks were recorded, but these appeared to be temporary. In Colorado County, at about noon on September 1, 1937, a flock of 15 to 25 birds was noticed in a cotton field. On the following 3 days at the same hour 11, 15, and 9 birds, respectively, were present in that field; but they had come in between 9:30 and 11:30 as singles, pairs, and in small groups not exceeding 5 birds each. Between 4 p. m. and dark they left the field as they had come. Again in Colorado County, at 6 p. m. on September 3, 1937, another group of 16 birds found in a pasture came together as follows: At 5:40 p. m. a group

of 8 flushed approximately 1 mile from the spot where the large flock was later noted, and as they flew over the prairie, a pair, a single, a trio, and another pair joined the original group. All settled and fed together for a time, but the bevy disintegrated by dusk. Like instances suggest that early fall flocks of a dozen or so birds are unstable groups brought together largely by chance.

In fall, after the weather turned cool, groups of prairie chickens became the rule rather than the exception. Early November be vies generally contained 4 to 12 birds each, but large flocks became increasingly common from about December 1 to the onset of the breeding season. Late in winter (January) Guy Ferguson, State game warden, Sinton, Tex., observed flocks in Refugio and Aransas Counties that contained more than a hundred birds. Wardens Waddell in Colorado, Austin, and Wharton Counties, and McClosky in Victoria County, reported winter aggregations of about the same size. In 1936, J. O. Linney, foreman, Salt Creek (Hallahan) ranch, Refugio and Aransas Counties, noticed late winter concentrations estimated to contain 250 to 300 individuals. The writer has not observed such large winter flocks, possibly because he has not made observations in areas where the birds were sufficiently numerous. January assemblages of 25 to 35 birds were not uncommon, however, in Colorado County. Despite the fact that large flocks became more frequent from November until the breeding season, small groups of 8 or fewer birds or singles were always to be found. All packs observed in Colorado County late in November, December and January contained birds of only one sex. Late in January, residents of the coastal country eagerly listen for the first booming calls, which, besides promoting rapid disintegration of winter flocks, signal the departure of winter and the coming of spring.

#### SEASONAL MOVEMENTS

##### SPRING

Comprehensive data on prairie chicken movements are lacking, but the records obtained in 1937 are of interest. Two broods that were observed two or more times daily from the time they were hatched until they were 7 and 12 days old, respectively, were, at last observation, less than half a mile from the nest sites. Another brood, estimated to be 8 days old when first discovered on June 2, was within 150 yards of the same spot at various hours during the next 6 days. A fourth brood, about 3 days old on April 29, remained within 400 yards of a certain windmill from April 29 through May 31. A 640-acre pasture that contained four broods, all under 2 weeks of age when rope counted on June 2, likewise harbored four broods 10 days later.

If this is indicative, the prairie chickens under observation spent their first several weeks of life in close proximity to the places where hatched. The daily cruising radius of a brood apparently was small, seemingly less than 300 yards in the case of birds under 4 weeks old in a favorable environment. Some 30 broods observed between May 1 and June 1 were found in light cover on or near hardpan flats and recent burns, indicating a distinct preference for those types of habitat.

#### SUMMER

An extensive movement involving both young and adult prairie chickens in Colorado County began about June 1, 1937, when many of the young were 3 to 5 weeks old, and lasted until about June 30. The sudden scarcity of the birds in places where they had been common only a few days before was striking. A 1,000-acre pasture that contained 37 individuals (16 old and 21 young) on June 2, held only 16 in all on June 10. As the prairie chickens decreased in some pastures, they increased in others. A 460-acre pasture that was unoccupied on May 1 contained 14 birds on June 8 and 23 on July 26.

This movement from the spring range was by stages. One brood that was watched closely made trips of approximately 1 mile, three-fourths mile, and  $1\frac{1}{4}$  miles in 6 days from June 2 through June 8. After the first major movement, this family remained for 3 days in an area less than 500 yards in diameter; their droppings in piles formed a triangle with sides of 5, 15, and 17 yards, respectively. The movement of a combined brood of 3 hens and 16 to 25 young are recorded in figure 2, p. 23.

Leopold (1933: 291) reports that—

All observers unanimously and independently report a strong tendency for the grown young of most species of grouse to seek the vicinity of drinking water in late summer and fall, but whether they do this out of choice or necessity is not known.

The early summer movement of young and adult Attwater's prairie chickens also was to the vicinity of surface water, but it was to water near which there also was shade. Pastures having an abundance of surface water but little or no shade-producing cover had few if any birds after mid-June. Likewise, places in which dense stands of weeds, shrubs, or tall grass were abundant, but surface water scarce, were sparsely populated. More than 95 percent of the more than 500 Attwater's prairie chickens observed from June 24 through September 4, 1937, were in heavy cover within a mile, generally within less than half a mile of surface water.

The beginning of the summer movement is synchronous with the drying up of the wild indigo (*Baptisia*, pl. 7), a plant that furnishes the principal shade on burns and heavily grazed areas from April through May. Prairie chickens require abundant shade in sum-



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*Above*, Wild indigo (*Baptisia*) in a closely grazed pasture; Austin County, Tex., approximately 8 miles southeast of Sealy, April 10, 1938. *Below*, Shocked grain and waste in rice fields sometimes attract prairie chickens; Colorado County, Tex., 3 miles northeast of Eagle Lake, September 5, 1936. (Photos by V. W. Lehmann.)



mer, for birds that were herded from such cover at midday panted vigorously, drooped their wings, and showed other signs of discomfort. They evidently rarely drink from surface water. In 1937, birds near water were closely observed, but only one was seen to drink during the entire summer. That was in Colorado County on June 1, 1937, when a chick about 3 weeks old drank a few times from a puddle formed by water from a leaking windmill. The soft mud bordering ponds in inhabited prairie chicken range in Brazoria, Colorado, and Austin Counties was examined thoroughly at various times, but tracks of this species were never found. Grasshoppers

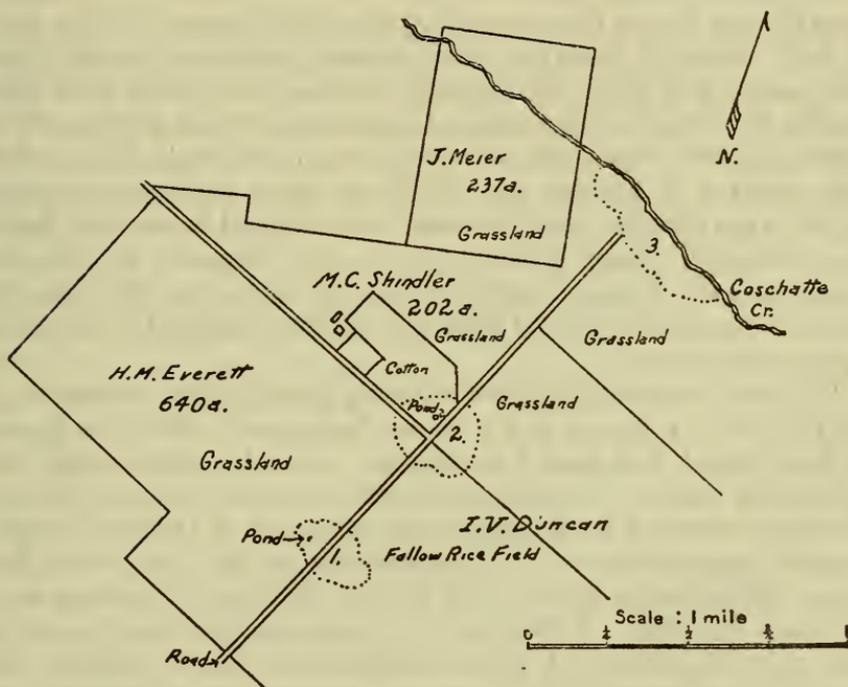


FIGURE 2.—Movements of a combined brood, May 1 to July 26, 1937, Colorado County. Birds seen in areas as follows: 1, May 1 to 28; 2, June 10 to July 10; 3, July 15 to 26.

and other favorite foods were frequently more abundant in summer in heavy cover near water, but the food factor was not thought to be of great importance at the time. The summer movements of prairie chickens to heavy cover near water are not satisfactorily explainable on the basis of cover, water, and food, but these habitat conditions must be provided where stable populations are desired.

After they found a satisfactory summer range, the prairie chickens moved little until fall, unless their summer territory was depleted or that nearby was more suitable. The population of a 460-acre pasture in Colorado County remained at nearly the same level (25

to 36 birds) from July 26 through September 3, 1937. The birds that rested in this area at noon each day, however, foraged and roosted largely in adjoining pastures, but their range was never more than  $1\frac{1}{4}$  miles and usually under half a mile.

Rains in 1937 sufficiently heavy to collect in low spots caused temporary spreading of prairie chickens from previously occupied areas. As the temporary water disappeared, however, the birds again concentrated.

#### FALL AND WINTER

Populations that had been rather stable in certain pastures in Colorado County during the summer months of 1937 began shifting early in fall. About 25 birds that were summer residents of the M. Shindler cotton field from July through August were absent after September 4. Two thousand acres of regularly censused pasture where prairie chickens were common in summer contained only 9 birds when rope counted on October 22. While the birds decreased generally in the large pastures, they increased around small farms near Sealy, Austin County; Lissie, Wharton County; and Bernardo and Chesterville, Colorado County—territory 5 to 10 miles removed from the pastures in which birds had been most common during the preceding spring and summer.

Distances traveled daily were evidently great in some instances. A bird killed by a farmer at 8 a. m. on September 1, 1936, was known to have traveled at least 3 miles since dawn, because its crop was filled with rice and the nearest rice field was that distant. Two individuals, observed for 2 hours on the afternoon of October 22, 1937, traveled approximately  $1\frac{1}{4}$  miles southeast of the point where first seen. When finally flushed, they flew an additional 2 miles or so in the same direction. A flock of four birds observed from 4 p. m. to 6:15 p. m. on January 4, 1938, traveled more than  $1\frac{3}{4}$  miles. The movement was in a circular direction, however, for at nightfall, the birds were less than half a mile from the point where they were first observed. Cool weather, fall rains, and a seasonal abundance of food and cover, especially in the vicinity of farming communities, probably were important in promoting the general fall scattering and the long daily trips the prairie chickens made in territory that was sparsely populated at other seasons. The birds reconcentrated in large pastures, however, as fall passed into winter.

The population of the Everett pasture (640 acres), Colorado County, increased from November 3, 1937, through January 28, 1938; five censuses during that period showing 46, 58, 56 to 58, 73, and 84 birds, respectively. Excellent food and cover conditions prevailed, for the area was lightly grazed. This increase in the number of birds apparently resulted from influxes from adjoining areas. After

November 15, few fluctuations in numbers between different pastures were reported by fence riders and others. Pastures that contained the greatest numbers in November and December 1937 also harbored the largest breeding populations the following spring.

The data at hand show that late in fall, probably by about November 15, the prairie chickens move to pastures where food and cover conditions are adequate. Having found such an area, they remain until spring. Probably the best way to attract a good breeding population, therefore, is to provide suitable food and cover conditions during the preceding winter.

#### FOOD

Data on the food of Attwater's prairie chicken were derived mainly from analyses of 21 stomachs (crops, or gizzards, or both) and more than 200 droppings (scats). Additional information was obtained by watching feeding birds at close range through field glasses. Of the 21 stomachs, 18 were of adult prairie chickens, 2 of chicks approximately 10 days old, and 1 of a juvenile about 7 weeks old. Specimens were obtained as follows: 6 in winter (January and February), 5 in spring (April and May), 5 in summer (June through August), and 5 in fall (September through November). J. H. Gaut collected 3 stomachs near East Bernard, Wharton County, in May 1905. Over the period beginning September 1936 and ending August 1938, 2 stomachs were obtained in Austin County, 4 in Refugio County, and 12 in Colorado County. As the crops and gizzards of all birds found killed by automobiles, predators, poachers, and from other causes were saved, it was necessary to collect only 11 specimens to balance the series according to seasons.

Except during the breeding season, adult prairie chickens regularly feed twice daily, early in the morning (dawn to about 8 a. m.), and late in the afternoon (4 p. m. to dark). Occasional bits of food are picked up throughout the day, but the gullets of specimens collected about noon are usually empty or nearly so. The food capacity of prairie chickens is large. Gullets frequently contain about 20 cubic centimeters, and the gizzard about 30 cubic centimeters, of material. Since the birds ordinarily feed slowly and deliberately, apparently selecting their food with great care, it is not surprising that their diet in favorable areas is varied. Stomachs have been examined that contained 29 kinds of food and more than 1,300 items; stomachs rarely contain less than 13 kinds of food of 500 items. Mature birds evidently feed mostly on vegetation at all seasons, for the stomachs of 18 adults (table 6, p. 26) contained 88.28 percent of plant material and 11.72 percent of insects. Animal matter probably ranks higher than plants in the diet of young birds, however,

for the stomachs of 2 chicks and a juvenile (table 7, below) contained 88.5 percent of insects. The ratio of plant to animal food varies according to season (table 8, below), insects, for instance, apparently being eaten in greatest quantity in summer.

TABLE 6.—Composition of the stomach<sup>1</sup> contents of 18 adult prairie chickens

Item	Stomachs in which found		Item	Stomachs in which found	
	Number	Percent		Number	Percent
Vegetable matter.....	18	88.28	Animal matter.....	18	11.72
Leaves and stems.....	12	27.11	Insects:		
Seeds and pods.....	16	55.67	Adults.....	17	10.83
Buds and flowers.....	5	1.30	Eggs and larvae..	8	0.89
Miscellaneous <sup>2</sup> .....	6	4.20	Round worms.....	1	(3)
			Prairie chicken feathers.....	1	(3)
			Grit.....	11	(3)

<sup>1</sup> Crops or gizzards, or both.

<sup>2</sup> Woody pod septa, root stocks, and the like.

<sup>3</sup> Trace.

TABLE 7.—Composition of the stomach contents of three young prairie chickens

Item	Stomachs in which found		Item	Stomachs in which found	
	Number	Percent		Number	Percent
Vegetable matter.....	2	11.5	Animal matter.....	3	88.5
Seeds or pods.....	2	1.5	Insects:		
Unidentified material.	1	10.0	Adults.....	3	86.0
			Eggs or larvae....	2	2.5

TABLE 8.—Percentage of plant and animal food according to season

Item	Spring	Summer	Fall	Winter	Whole year
Plants.....	94.25	71.0	85.8	95.0	86.51
Insects.....	5.75	29.0	14.2	5.0	13.49
Total.....	100.00	100.0	100.0	100.0	100.00

The data at hand indicate that Attwater's prairie chickens are preponderantly granivorous, for seeds and seed pods made up slightly more than 50 percent of all the material in the stomachs of 18 adults. Much succulent vegetation is eaten, however, including leaves, buds, flowers, and root stocks. The birds also consume insect eggs, larvae, and adults, as shown in tables 6 and 7.

Parts of some 50 kinds of plants and more than 65 species of insects were identified in the food from stomachs or scats, or by observations in the field. The names of these plants and insects together with the seasons when they are known to be eaten, are listed in tables 9 and 10, pp. 27 and 28.

TABLE 9.—Plant foods (56) of Attwater's prairie chicken

Plant	Parts eaten	Seasons when eaten <sup>1</sup>	Source of data <sup>2</sup>
Marsileaceae: Pepperwort ( <i>Marsilea</i> )	Leaves	Wi	St.
Poaceae:			
Paspalum ( <i>Paspalum ciliatifolium</i> type)	Leaves, seeds	Sp, su, au, wi	St, sc.
Bull grass ( <i>Paspalum boscianum</i> ?)	Seeds	Au	St.
Paspalum ( <i>Paspalum plicatulum</i> )	do	Sp, su, au	St.
Panic grass ( <i>Panicum scribnerianum</i> )	do	Sp	St.
Panic grass ( <i>Panicum spp.</i> )	do	Sp	St.
Crabgrass ( <i>Digitaria</i> )	do	Au	St.
Sandbur ( <i>Cenchrus</i> )	do	Wi	St.
Hegari ( <i>Sorghum vulgare</i> )	do	Su, au	Si.
Rice ( <i>Oryza sativa</i> )	do	Au, wi	Si, st.
Corn ( <i>Zea mays</i> )	do	Sp	St.
Cyperaceae:			
Beakrush ( <i>Rhynchospora</i> )	do	Su, au, wi	St.
Sedge ( <i>Carex</i> )	Seeds, leaves	Au	St.
Commelinaceae: Dayflower ( <i>Commelina crispata</i> )	Leaves, seeds	Au	St.
Alliaceae: Wild onion ( <i>Nothoscordum bivalve</i> )	Leaves, flowers	Wi	St.
Liliaceae: (Undetermined)	Seeds	Su, wi	St.
Leucojaceae: Stargrass ( <i>Hypoxis</i> )	Leaves, seeds	Sp	St, si.
Convallariaceae: Solomons seal ( <i>Polygonatum commutatum</i> )	Seeds	Su	St.
Xiaceae: Blue-eyed-grass ( <i>Sisyrinchium varians</i> )	Seeds, pods	Sp, su	St.
Polygonaceae: Dock ( <i>Rumex</i> near <i>crispus</i> type)	Seeds	Wi	St.
Ranunculaceae: Buttercup ( <i>Ranunculus near hispidus</i> )	Leaves, seeds, pods	Wi, sp	St.
Rosaceae: Dewberry ( <i>Rubus</i> )	Seeds, fruits	Sp	St.
Malaceae: Chokeberry ( <i>Pyrus</i> )	Flowers, fruits	Sp	St, si.
Mimosaceae:			
Sensitive briar ( <i>Neptunia lutea</i> )	Leaves, flowers, seeds	Au, wi, sp	St, si.
Mimosa ( <i>Mimosa</i> )	Leaves, seeds	Su, au, wi	St, sc.
Acacia ( <i>Acacia</i> )	Seeds	Wi	St.
Cassiaeae: Partridge-pea ( <i>Chamaecrista fasciculata</i> )	Seeds, flowers	Su, au	St, si.
Fabaceae:			
Wild pea (undet.)	Flowers	Sp	St.
Wild pea ( <i>Lathyrus pusillus</i> )	Leaves	Wi	St.
Peanuts ( <i>Arachis hypogaea</i> )	Fruits	Au	Si.
Oxalidaceae: Woodsorrel ( <i>Oxalis</i> )	Leaves, seeds	Wi, sp, su	St, sc, si.
Euphorbiaceae:			
Doveweed ( <i>Croton capitatus</i> )	Seeds	Au, wi	St, sc, si.
Doveweed ( <i>C. glandulosus</i> )	do	Au, wi	St.
Doveweed ( <i>C. monanthogynus</i> )	Seeds, leaves	Au	St, si.
Spurge ( <i>Euphorbia</i> )	Seeds	Au, wi, sp	St, sc.
Spurge ( <i>Crotonopsis linearis</i> )	do	Au	St.
Spurge ( <i>Chamaesyce</i> )	do	Au	St.
Vitaceae: Grape ( <i>Vitis</i> )	Seeds, fruits	Su	St.
Malvaceae: Mallow ( <i>Malva</i> )	Seeds, pods	Sp	St.
Epilobiaceae: Gaura ( <i>Gaura</i> )	Pods	Sp	St.
Ammiaceae ( <i>Cynosciadium</i> )	Leaves	Wi	St.
Convolvulaceae:			
Bindweed ( <i>Convolvulus</i> )	Seeds	Sp	St.
<i>Evolvulus</i>	Seeds, pods	Sp	St.
Polemoniaceae: Phlox ( <i>Phlox drummondii</i> )	Seeds, pods, flowers	Sp, su	St, sc.
Boraginaceae: Gromwell ( <i>Lithospermum</i> )	Seeds	Su	St.
Verbenaceae:			
Fog fruit ( <i>Phyla nodiflora</i> )	Leaves, flowers, fruit	Sp, wi, au	St, si.
Verbena ( <i>Verbena</i> )	Leaves	Wi	St.
Acanthaceae: Ruellia ( <i>Ruellia ciliosa</i> var. <i>humilis</i> )	Leaves, stems, seeds, buds, pods, flowers.	Au, wi	St, sc, si.
Rubiaceae:			
Buttonweed ( <i>Diodia teres</i> )	Seeds	Su, au, wi	St, sc.
Buttonweed ( <i>Diodia virginiana</i> )	do	Su	St.
Bedstraw ( <i>Galium</i> )	Leaves, seeds	Sp, su, au	St, sc.
Ambrosiaceae:			
Marsh-elder ( <i>Iva ciliata</i> )	do	Wi	St, si.
Perennial ragweed ( <i>Ambrosia psilostachya</i> )	Seeds	Au, wi	St, sc.
Carduaceae:			
Thistle ( <i>Carduus</i> )	do	Sp	St.
Tickweed ( <i>Coreopsis</i> )	Flowers	Sp	Si.
Cichoriaceae: ( <i>Serinea oppositifolia</i> )	Seeds, pods	Sp, su	St, sc.

<sup>1</sup> Abbreviations of seasons: Sp, spring; Su, summer; Au, autumn; and Wi, winter.<sup>2</sup> Abbreviations of sources: St, stomach examination; Sc, scat examination; and Si, sight record.

TABLE 10.—Some insect foods (68) of Attwater's prairie chicken

Name	Form eaten	Seasons when eaten <sup>1</sup>	Source of data <sup>2</sup>
<b>Araneida:</b>			
Spider ( <i>Lycosidae</i> )	Adult	Au	St.
Spider (undetermined)	do	Su, au	St.
<b>Orthoptera:</b>			
Grasshopper ( <i>Cyrtacanthacrinae</i> )	do	Sp, su	St, sc.
Pigmy locust ( <i>Acrydinae</i> )	Adult, larva	Sp, su, au	St, sc.
Grasshopper ( <i>Syrbula</i> )	do	Au	St.
Grasshopper ( <i>Oedipodinae</i> )	do	Au	St.
Western grasshopper ( <i>Melanoplus cinereus</i> )	do	Su, au	St, sc.
Green grasshopper ( <i>Chortophaga viridifasciata</i> )	do	Su	St.
Grasshopper ( <i>Oedipodinae</i> )	do	Su	St, sc.
Grasshopper ( <i>Schistocerca americana</i> )	do	Su	St.
Grasshopper ( <i>Saltatoria</i> )	do	Su	St.
Meadow grasshopper ( <i>Conocephalus</i> )	do	Sp, su, au	St.
Long-horned grasshopper ( <i>Tettigoniidae</i> )	Adult, larva, egg	Su, au	St, sc.
<b>Hemiptera:</b>			
Shield bug ( <i>Pentatomidae</i> )	Adult	Sp	St.
Bug (undetermined Hemiptera)	Adult, eggs	Sp	St.
Stinkbug ( <i>Euschistus</i> )	Adult	Su	St, sc.
<b>Homoptera:</b>			
Leafhopper ( <i>Cicadellidae</i> )	do	Au, wi, sp	St.
Lantern fly ( <i>Fulgoridae</i> )	do	Sp, su, wi	St.
Soft scale ( <i>Leucanium</i> )	do	Au	St, sc.
<b>Coleoptera:</b>			
Weevil ( <i>Graphorhinus vadosus</i> )	do	Wi, sp	St.
Weevil ( <i>Litus</i> )	do	Su, wi	St.
Weevil ( <i>Thecesternus humeralis</i> )	do	Wi	St.
Billbug ( <i>Sphenophorus minutus</i> )	do	Sp	St.
Billbug ( <i>Sphenophorus bartramiae</i> )	do	Sp, au	St, sc.
Billbug ( <i>Sphenophorus germari</i> )	do	Sp, au	St, sc.
Billbug ( <i>Sphenophorus</i> )	do	Su, wi	St, sc.
Weevil ( <i>Baris</i> )	do	Sp, su	St.
Weevil ( <i>Hyperodes</i> )	do	Sp	St.
Rice-water weevil ( <i>Lissorhoptrus simplex</i> )	do	Sp	St.
Weevil ( <i>Pachyphanes</i> )	do	Sp	St.
Weevil ( <i>Anthonomus fulvus</i> )	do	Sp	St.
Snout beetle ( <i>Curculionidae</i> )	do	Sp, su	St, sc.
Weevil ( <i>Apion</i> )	do	Wi	St.
Scarred snout beetle ( <i>Tanymericus lacaena</i> )	do	Wi	St.
Scarred snout beetle ( <i>Eudiagogus pulcher</i> )	do	Au	St, sc.
Scarred snout beetle ( <i>Compsus auricephalus</i> )	do	Sp	St.
Leaf beetle ( <i>Phaedon viridis</i> )	do	Wi	St.
Leaf beetle ( <i>Cryptocephalus venustus</i> )	do	Su, au	St, sc.
Leaf beetle ( <i>Cryptocephalus</i> )	do	Su	Sc.
Leaf beetle ( <i>Zygogramma disrupia</i> )	do	Su, au	St, sc.
Leaf beetle ( <i>Oedionychis petaurista</i> )	do	Au	St.
Leaf beetle ( <i>Metacroma ustum</i> )	do	Au	St.
Leaf beetle ( <i>Disonycha</i> )	do	Sp, su, wi	St, sc.
Leaf beetle ( <i>Chrysomelidae</i> )	do	Sp, su, au	St, sc.
Leaf beetle ( <i>Calligrapha similis</i> )	do	Wi	St.
Leaf beetle ( <i>Graphops pubescens</i> )	do	Wi	St.
12-spotted cucumber beetle ( <i>Diabrotica duodecimpunctata</i> )	do	Wi	St.
May beetle ( <i>Phyllophaga</i> )	do	Sp	St.
May beetle ( <i>Scarabaeidae</i> )	do	Su, au	St.
Leaf chafer ( <i>Anomala ludoviciana</i> )	do	Au	St.
Dung beetle ( <i>Aphodius sp.</i> )	do	Sp	St.
Ground beetle ( <i>Tripterus</i> )	do	Au, wi	St.
Ground beetle ( <i>Eumolops</i> )	do	Wi	St.
Ground beetle ( <i>Carabidae</i> )	do	Sp, su, au	St, sc.
Ground beetle ( <i>Chaenius</i> )	do	Su	Sc.
Darkling beetle ( <i>Tenebrionidae</i> )	do	Au	Sc.
<b>Lepidoptera:</b>			
Moths, butterflies, and skippers (3 species)	Adult, larva	Su, au	Sc.
Salt-marsh caterpillar ( <i>Estigmene acrea</i> )	do	Su, au	Sc.
<b>Diptera:</b>			
Gall gnat ( <i>Cecidomyiidae</i> )	Larva	Sp	St.
Robber fly ( <i>Asilus</i> )	Adult	Au	St.
<b>Hymenoptera:</b>			
Gall fly ( <i>Cynipidae</i> )	Adult, eggs	Sp	St.
Chalcid fly ( <i>Chalcidae</i> )	Adult	Su	Sc.
Paper wasp ( <i>Polistes</i> )	Adult, pupa cases	Su, wi	St.
Ant ( <i>Odontomachus haematodes</i> )	Adult	Wi	St.
Ant ( <i>Pheidole sp.</i> )	do	Su	St.
Fire ant ( <i>Solenopsis sp.</i> )	do	Su	St.

<sup>1</sup> See footnote 1, table 9.<sup>2</sup> See footnote 2, table 9.

Native plants are the most important source of food for the prairie chicken. Rated according to frequency of occurrence in stomachs and scats, gross bulk, and periods of availability, ruellia (*Ruellia*) appears to be by far the most important single food. It occurred in 13 of the 18 stomachs and made up almost 27 percent of all the material eaten. Stargrass (*Hypoxis*), bedstraw (*Galium*), doveweed (*Croton*), perennial ragweed (*Ambrosia psilostachya*) also were eaten freely through long seasons. Practically all the important food plants utilized by the prairie chicken grow naturally in pastures that are moderately grazed. Corn was the only cultivated grain found, and the small quantity present was probably waste. It is known, however, that prairie chickens are fond of certain crops, especially peanuts, hegari, and ripened rice. The birds frequently congregate in peanut patches, particularly after the harvest, and scratch for the waste pods. They also use conveniently situated hegari fields extensively in summer, but the good shade in such areas is probably as attractive as the grain. Prairie chickens also range into rice fields after the crop is cut and shocked, and they sometimes feed on the grain in the shock as well as on that so freely wasted on the ground (pl. 7). The rice taken from shocks usually is not objectionable, although L. D. Roberts, Eagle Lake, Tex., reports that he saw approximately 1,500 of the birds feeding in a single field of about 500 acres in the Egypt section, Wharton County, in September 1920. By scratching, the prairie chickens loosen the shocks, thus allowing moisture to seep in, and this causes some complaint. A large increase of prairie chickens might conceivably bring on control problems in certain areas. The difficulties would probably not be serious, however, because the birds could easily be frightened by shotgun fire or by other disturbances, and they quickly desert areas of potential danger.

Among insect foods of Attwater's prairie chicken, 11 grasshoppers (6 identified to genus or species) are especially prominent; 32 beetles (identified to genus or species, including 16 weevils) also are important. The vast majority (50 of 65) of the insects eaten by prairie chickens are kinds neutral (25) or harmful (25) to agriculture. Field observations, and reports of cooperators, show that prairie chickens eat in large quantities the moths of the cotton leaf worm (*Alabama argillacea*), one of the worst insect pests in the coastal area. Under ordinary conditions, the food habits of Attwater's prairie chicken, considering both insect and plant consumption, are such as to make it one of the most valuable birds of farm and range.

## HABITAT REQUIREMENTS

### KIND OF HABITAT BEST SUITED

The coastal prairie grassland is the real home of Attwater's prairie chicken, particularly in areas characterized by diversity of vegetation (pl. 8). Woodland, brushland, and cultivated land each furnish some food and cover at certain times and under certain conditions, but use of these types is optional with the prairie chicken, not vital. These secondary habitats are frequented mostly when food and cover are at the annual peak, as in September and October, but are little used at times of seasonal scarcity, as in December, January, February, and early in March. Wooded, cultivated, and brushy areas, individually or in combination, contribute little or nothing as courtship grounds and nesting cover. Properly managed grassland (pl. 9), however, satisfies every known requirement of Attwater's prairie chicken, and management, therefore, should be directed toward improvement of these areas.

### CHARACTER AND DENSITY OF VEGETATION

Optimum food and cover conditions seemingly are approached when the prairie vegetation is varied in species, interspersion, and density. The plant life of well-populated areas includes a variety of grasses, sedges, rushes, and legumes, and tall weeds or their cover equivalent in the form of scattered clumps of myrtle or live-oak brush. The combination and density of the plants in the most favored places invariably is such as to provide cover in all degrees and well distributed.

Light cover serves (1) exclusively for the courtship performance, (2) for feeding at all seasons, and (3) for a resort when dew is heavy or after rains. Light to medium heavy cover is used (1) for roosting, especially on gentle slopes, (2) by chicks under 5 weeks old, and (3) for feeding by adults throughout the year. Cover of a medium heavy to heavy character (pl. 9) is utilized (1) extensively for nesting, (2) as a loafing cover except during the hot summer months, and (3) as feeding grounds and escape cover in emergencies. Heavy cover (pl. 9) is essential (1) for shade in summer, (2) for protection against unfavorable weather and predators at other seasons, and (3) as a source of food, especially in fall.

### TOPOGRAPHY

Richness and variety in the vegetation are promoted by even slight variations in topography and soil (pl. 8). Consequently, the best natural range for Attwater's prairie chicken comprises country in which knolls, ridges, or hog wallows, are frequent. Further, knolls



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*Above*, Diversified cover—excellent prairie chicken range; Colorado County, Tex., approximately 7 miles northeast of Eagle Lake, September 4, 1936. *Below*, Diversity of topography and vegetation; Austin County, Tex., approximately 6 miles northeast of Bellville, June 13, 1936. (Photos by V. W. Lehmann.)



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*Above*, Medium-heavy to heavy cover—excellent food-cover conditions in a moderately grazed pasture; Colorado County, Tex., approximately 8 miles north of Eagle Lake, December 21, 1936. *Below*, Heavy cover, mostly myrtle brush, near stream—excellent summer range; Austin County, Tex., approximately 4 miles east of Bellville, July 14, 1936. (Photos by V. W. Lehmann.)

and ridges are least likely to be inundated in times of flood and they afford the birds better opportunity of eluding their natural enemies and man.

#### WATER

The balanced prairie chicken habitat should offer a generous supply of surface water throughout the year. Although Attwater's prairie chickens may not be dependent on free water for survival during normal years (see p. 23), it has been established that their favorite summer range is rather well watered. During unusually dry years such as occurred in Refugio County in 1917, surface water may be an absolute necessity. Also, through its effects on vegetation and insect life, water is necessary for the maintenance of optimum cover and food conditions. The water supply of prairie chicken areas apparently is about optimum when permanent sources are available throughout the range at intervals not greater than a mile.

Briefly, then, habitat conditions for Attwater's prairie chickens seemingly approach the ideal in grassland area when (1) the vegetation is diversified and native grasses, sedges, legumes, and small and large weeds, or their equivalent in the form of brush or dwarfed trees, are present in such stands as to provide all densities of cover; (2) knolls, ridges, and hog wallows are frequent and the soils vary from loose sand to tight clay or silt; and (3) permanent sources of surface water are available not more than a mile apart.

#### SEASONS OF SCARCITY

In evaluating the suitability of an area for Attwater's prairie chickens it is to be kept in mind that its productivity or carrying capacity is not determined by conditions during the best season in a good year. Rather, as Taylor (1934) states, conditions that prevail during the most critical season of the year and in the most extreme year in a series of years determine carrying capacity. In the coastal country of Texas the season of scarcity, or the period when food and cover are at a minimum, normally is from December through early March. The most critical years are those of heavy rainfall in May.

#### LIMITING FACTORS

Factors that have contributed to the decrease of prairie chickens in Texas may be classed roughly as (1) natural, including unfavorable weather, predators, and disease; and (2) artificial, including cultivation, heavy grazing, burning, and overshooting. It might be more accurate to class limiting factors as those brought about by man, directly or indirectly. Although it is not generally appreciated, the decrease of prairie chickens in coastal Texas corresponds

with the spread of civilization. Prior to the coming of white men, the number of birds probably was well maintained, but there was a decrease as the country was developed. Attwater's prairie chicken will become extinct unless man ceases to exploit the soil, water, and other natural resources of its range.

#### NATURAL FACTORS

##### RAINFALL DURING THE NESTING SEASON

Prairie chickens in Texas evidently suffer greatly at times from extremes of weather. Heavy precipitation during the nesting and brooding season (March through June) appears to be an especially serious hazard, as indicated by the studies of Waddell and others in Colorado, Austin, and Wharton Counties. From 1925 through 1937 Waddell estimated the size of the annual crop of young prairie chickens on the basis of the number of birds, both young and old (1) observed on almost daily trips through their range, (2) seen by reliable resident observers, (3) bagged by hunters, and (4) counted annually on the courtship grounds in spring. From his studies he concluded that crops of young prairie chickens were (1) good in spring months when rainfall was below average, (2) fair to good when rainfall was average or only slightly above average, and (3) poor, very few young being reared, when the nesting season was abnormally wet.

Waddell's impressions as to the correlation between the amount of precipitation in spring and the size of the annual crop of chickens were tested rather thoroughly in 1936 and again in 1937. In August 1936, after a reconnaissance made with car and dog (see p. 52) over approximately 25,000 acres of territory in Colorado and Austin Counties, it was estimated that the annual increase was less than 10 percent. Rainfall there was below average in March, April, and June 1936, but it exceeded 10 inches, or approximately twice the average, in May, as shown by the records of the Weather Bureau at Columbus, situated centrally in that area. In 1937, when records of this station showed that rainfall was 2 inches or more below average in April, May, and June, rope counts made of 3,450 acres both before and after the breeding season revealed a 95-percent increase, supporting Waddell's estimate that the increase was good in a dry season.

In table 11, p. 33, Waddell's estimates of the favorableness of the years from 1925 through 1937 for prairie chicken reproduction are presented together with precipitation records of the Columbus Weather Bureau Station for March, April, May, and June in those years.

TABLE 11.—*Reproductive yield of Attwater's prairie chicken in relation to spring rainfall in inches<sup>1</sup> in the Colorado County area<sup>2</sup>*

Year	Estimated yield	March		April		May		June	
		Precipitation	Departure from normal						
1925	Good	0.33	-2.50	0.99	-2.74	2.87	-1.51	1.06	-2.12
1926	Fair	11.54	-8.71	7.86	4.13	4.10	-.28	3.37	.19
1927	Good	3.49	-.66	4.00	.27	1.24	-3.14	6.43	3.25
1928	do	1.42	-1.41	3.76	-.03	2.00	-2.38	8.52	5.34
1929	Poor	4.54	1.71	2.58	-1.15	16.12	11.74	.99	-2.19
1930	Fair	2.34	-.49	.48	-3.25	3.11	1.27	.89	-2.29
1931	Good	3.84	1.01	1.43	-2.30	1.98	-2.40	.90	-2.28
1932	do	3.63	.80	2.19	-1.54	.66	-3.72	3.68	.50
1933	Fair	2.36	-.47	1.43	-2.30	3.67	-.71	1.40	-1.78
1934	Good	3.91	1.08	4.28	.55	1.90	-2.48	.22	-2.96
1935	Poor	3.72	.89	4.58	.85	9.21	4.83	2.48	-.70
1936	do	1.23	-1.60	3.48	-.25	10.65	6.27	.79	-2.39
1937	Good	6.01	3.15	.52	-3.21	.47	-3.91	1.37	-1.81

<sup>1</sup> Records of U. S. Weather Bureau Station, Columbus, Colorado County.

<sup>2</sup> Colorado County, north central Wharton County, southwestern Austin County.

Waddell found good crops of young birds in the Eagle Lake area in 1925, 1927, 1928, 1931, 1932, 1934, and 1937, years when rainfall in May was 1.5 inches or more below average. Fair crops of young prairie chickens were thought to have been reared in 1926, 1930, and 1933, when rainfall in May was approximately average (0.28 below in 1926) to only slightly above (1.27 above in 1930). Poor crops were matured in 1929, 1935, and 1936, when May precipitation was appreciably above (approximately twice) the average for that month. Unusually heavy or light precipitation in March, April, or June evidently had little influence on the broods of young, for good crops were recorded in 1927, when rainfall was decidedly above average in June, and a poor crop is known to have occurred in 1936, when rainfall was below average in all months of the nesting season except May. The records at hand suggest, therefore, that the rainfall in May is a fairly satisfactory index of the suitability of the year for the reproduction of Attwater's prairie chicken under natural conditions. Good crops usually result when the rainfall in May is 1.5 inches or so below average; fair crops are probable when it is approximately average or only slightly above; and poor crops appear almost a certainty when the rainfall for that month is decidedly above average.

Rainfall in May is of greater significance than that in any other month, as the 1937 and 1938 nesting studies showed that most of the chicks hatch in May. Those hatched in April do not yet have a serviceable covering of feathers by May and, consequently, are almost as vulnerable to the rains as are birds hatched in that month. Nests flooded in March and April may be rebuilt, for the booming season is still in full swing, but nests flooded after May 1 are seldom re-

established because the mating season is then nearly over. May, then, is the climax, or peak month, of the breeding season, and rainfall then is of greater significance than at any other period.

The nature of rains in May may be a factor modifying the use of precipitation records for that month as indices of the number of chicks produced, as short, heavy downpours may be more serious than slow steady rains. This, however, is not known to be true. Frequently recurring light rains may be as serious as heavy ones because persistent damp conditions result in heavy juvenile mortality from chilling. Stoddard (1931: 39, 202) shows that wet spring months are favorable for hatching but not for rearing bobwhites. Percolation and drainage are slow in the heavy coastal prairie soil, and surface moisture accumulates from persistent light rains as surely as from brief heavy ones; the amount rather than the severity of the rain seems to rule.

While it is realized that annual precipitation, drainage, cover, and other environmental conditions in Colorado County are not identical with those obtaining throughout the coastal prairie chicken country, a marked similarity does, nevertheless, exist. Rainfall is moderately heavy, 39 inches annually, at Columbus, Colorado County, and it is also generous throughout the bird's range. Average annual precipitation varies from 49.35 inches at Beaumont, Jefferson County, to 33.69 inches at Austwell, Refugio County, at about the eastern and western limits, respectively, of the subspecies. Rainfall during May at Columbus (average, 4.38 inches) is heavier than in any other month. May is the wettest month in Jackson, Goliad, Lavaca, and Harris Counties as well. Heavy or persistent rains transform tremendous areas in Colorado County into veritable lakes ranging from a few inches to several feet in depth; rains produce similar results throughout the coastal region. It appears justifiable, therefore, to assume that rainfall in May is the key to prairie chicken reproduction throughout coastal Texas (fig. 3).

Of every 5 years in a given locality, apparently 2 are favorable for nesting, 2 fair to poor, and 1 bad, as determined by rainfall in May. Conditions are never uniform in the chicken country as a whole because there is variation between counties and even between parts of the same county. Records of the Weather Bureau for May 1935 show, for example, that rainfall at Galveston, Galveston County, was favorable (2.71 inches below average); at Houston, Harris County, fair (only 0.20 inch below); and that at Columbus, Colorado County, poor, being approximately twice average (4.83 inches above). During 1926 in Brazoria County conditions were good at Alvin, fair at Angleton and Freeport, and poor at Brazoria. In 1932 conditions were good at Angleton, fair at Freeport, and poor at Alvin. Though man cannot regulate rainfall to promote prairie chicken welfare





at nesting and brooding time, in many cases he can regulate pasture burning and grazing to provide adequate nesting cover in the best-drained parts of the land. Also, he can consult weather records before setting open seasons and bag limits, which should not be uniformly applied but adjusted to local conditions to preserve the birds.

#### FLOODS

Flood conditions are often produced by heavy rains in the overgrazed and overfarmed sections in the upper part of the State. Heavily burdened streams carrying flood crests from the upper country sometimes spill over their low banks and spread their silt-laden waters over thousands of acres of prairie chicken range. This occurred in the Rock Island-Garwood section (Colorado County) in June 1936, when the prairie chicken population of that section was extirpated. Floods evidently are a constant menace to birds near major streams.

#### DROUGHT

Extreme drought seriously affects prairie chickens, especially during the hot summer months. G. P. Ferguson, State game warden, and fence riders on the M. O'Conner ranch, Refugio County, found many dead birds in the especially dry summer of 1917 and saw others too weak to fly. Drought reduces food supplies for both present and future use. Large cracks that form in black soil in dry weather possibly trap some young birds, according to the observations of Gross (Bent 1932: 253). Birds weakened by excessive heat, and possibly also by a shortage of food, are especially vulnerable to disease, predators, adverse weather, and other hazards.

#### HURRICANES

Tropical hurricanes sometimes produce flood conditions in prairie chicken country 20 miles or more from the Gulf. In 1917 a storm backed salt water over the greater part of the Pipkin ranch in the Big Hill area in Jefferson County and drowned livestock by the hundreds. That it evidently destroyed many prairie chickens as well was indicated by their exceeding scarcity for 15 years afterwards.

#### HAIL

Heavy hail storms destroy many Attwater's prairie chickens, especially in areas where heavy protective cover is lacking. After a storm in May 1934, J. O. Linney, Guy Ferguson, and fence riders on the Salt Creek ranch, Refugio County, saw about 150 dead or crippled chickens.

## LOCAL STORMS

Local storms, especially those that commonly occur in fall, kill turkeys and other domestic fowls and prairie chickens and other game birds, as reported by Marcus Shindler, Ed Koy, and other resident land-owners in the northeastern part of Colorado County.

## DISEASE

Gross (1930a: 39), and Stoddard, Curtis, Lews, Terrel, and others (Leopold 1931: 182-183), recorded incidents strongly suggesting that disease and parasites probably were important controlling factors on the abundance of the greater prairie chicken of the Northern States. Records at hand do not show that, in the past, disease has been a factor of importance limiting the numbers of Attwater's prairie chicken in Texas. The observations, mentioned above, made by G. P. Ferguson on the M. O'Conner ranch furnished the only known evidence even faintly suggesting an outbreak of disease. In that instance, however, it is probable that mortality, if really due to disease or parasites, was an indirect result of prolonged drought. No evidence of disease or heavy parasitism was found in autopsies made on 13 prairie chickens, and no evidence of any unhealthful condition was observed among hundreds of birds in the field. Prairie chickens are doubtless susceptible, however, to ailments of domestic poultry. An outbreak of blackhead disease, probably contracted from domestic turkeys, is considered by Gross (Bent 1932: 268) as a major factor in the extermination of the heath-hen. Turkeys and other poultry, therefore, probably are unhealthful influences on a prairie chicken range.

## SPREAD OF WOODY VEGETATION

The encroachment of mesquite, live oak, various acacias, and other kinds of brush onto open prairie land has been an extremely important factor in reducing the range and doubtless the numbers of Attwater's prairie chickens in Refugio and other counties to the south and west. Within the memory of living men extensive prairies have been transformed into brush jungles. Specific factors that have influenced the rapid vegetational changes in the southwestern brush country are imperfectly understood. Factors probably of importance in enabling woody plants to replace the native grassland flora have been overgrazing, especially during drought years; the mechanical planting of tree seeds by cattle and horses, because livestock eat large quantities of mesquite and other beans, the seeds of which pass through the digestive tract and are distributed or planted by the droppings; the elimination of burning, previously mentioned by Bray (1901: 288-290) and Tharp (1926: 71); and the lowering of the water table. Be that as it may, hundreds of thousands of acres of what was once

tall-grass prairie are now brushland, and prairie chickens are gone from these areas.

## PREDATION

## NESTS

Natural enemies consume some of the eggs, young, and adults of Attwater's prairie chicken. The extent of predation on nests and the identity of other factors responsible for nest loss in the Eagle Lake area are given in tables 12 and 13.

TABLE 12.—*Fate of nests, Eagle Lake, Colorado, 1937*

Nest No.	Pasture	Date found	Date destroyed or hatched	Probable cause of destruction
1.....	Everett.....	Apr. 7	Apr. 22	Man—nest deserted after entrance was widened by a farmer.
2 <sup>1</sup> .....	do.....	Apr. 8	Apr. 4 <sup>3</sup>	Red wolf—female bird killed on nest.
3 <sup>1</sup> .....	Wintermann.....	Apr. 12	Apr. 7	Opossum or skunk.
4.....	do.....	do.....	Apr. 13	Skunk.
5.....	Sklar-Marcella.....	Apr. 13	May 17	Hatched successfully.
6 <sup>1</sup> .....	Wintermann.....	Apr. 21	Apr. 15	Skunk.
7 <sup>1</sup> .....	do.....	do.....	Apr. 21	Do.
8 <sup>1</sup> .....	do.....	do.....	Apr. 18	Deserted, cause unknown.
9.....	Duncan.....	Apr. 27	May 4	Hatched successfully.
10.....	Everett.....	Apr. 29	May 15	Do.
11.....	Willis.....	May 1	May 2	Man—nest deserted after farmer plowed territory nearby and revisited nest frequently.
12 <sup>2</sup> .....	Sklar-Marcella.....	May 11	Apr. 6	Opossum.
13.....	do.....	June 1	June 2 or June 3	Hatched successfully.

<sup>1</sup> Nest destroyed when found.

<sup>2</sup> Estimated in case of nests destroyed when found.

<sup>3</sup> Indicated by circumstantial evidence at the nest.

TABLE 13.—*Fate of nests, Eagle Lake, Colorado County, Tex. (1938)*

Nest No.	Pasture	Date found	Date destroyed or hatched	Probable cause of destruction <sup>1</sup>
14.....	Sen.....	Apr. 13	May 3	Heavy rain.
15.....	Thomas.....	Apr. 18	Apr. 23	House cat.
16.....	do.....	do.....	Apr. 29	Hatched successfully.
17.....	do.....	Apr. 29	May 3	Heavy rain.
18.....	Everett.....	Apr. 20	May 11	Opossum.
19.....	do.....	June 3	June 21	Hatched successfully.

<sup>1</sup> Indicated by circumstantial evidence at nest.

Of 19 prairie chicken nests studied in 1937 and 1938, 6 (31.5 percent) were successful, and 13 (68.4 percent) were lost. In 1937 8 of 13 nests studied were destroyed before the clutches were complete, showing that the laying period may be the one of heaviest nest loss. This might be expected, as the eggs are covered only about an hour or so each day during that time. This loss is somewhat compensated, however, by renesting (see p. 15). Opossums and skunks destroyed 6 nests—more than any other agency. Of the 6,

however, 4 were in a pasture where unregulated fire had restricted good nesting cover to 2 small unburned areas about 3 and 10 acres in size. Fur animals as well as nesting chickens were unnaturally concentrated in these unburned plots; dens containing young were 100 yards or less from each of the nests destroyed. Excessive pasture burning appeared to be the primary cause of the heavy nest loss; predation by fur animals being merely an effect, the agency of destruction that was inevitable after the burning.

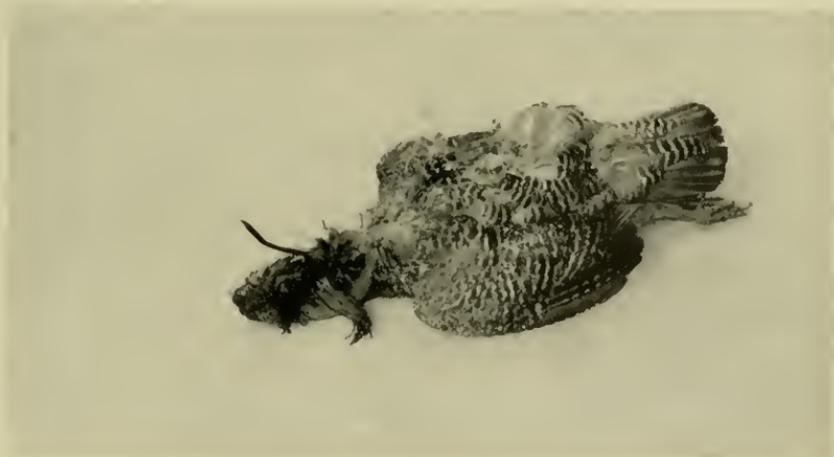
Field evidence showed that a red wolf killed a female prairie chicken and destroyed her nest; a feral house cat devoured the eggs from another nest (pl. 10). It is surprising that dogs did not figure as predators on the nests and that house cats did not take an even greater number. Wandering dogs, usually in groups of three to five, were not uncommon on Colorado County prairies; L. A. Burchfield, a trapper who worked for the former Bureau of Biological Survey in Colorado County in 1937, and Waddell found that dogs did much of the damage for which the few red wolves, now largely extirpated in the area, were blamed. Heavy predation on a flock of domestic turkeys, supposedly by wolves, stopped immediately when a hound, which frequently hunted on its own initiative, was killed after having been caught in a trap set for the alleged wolves. Feral house cats on Colorado County prairies probably outnumber skunks, opossums, minks, or any other fur animals. Cotton rats and other rodents were common near several nests but took no eggs. Neither did racers, chicken snakes, king snakes, or other reptiles frequently noted after May 1 in both 1937 and 1938.

Three nests were abandoned, desertion of two of these, possibly all three, being caused by man. Nesting prairie chickens seem especially sensitive to interference, and they should not be disturbed by persons making repeated visits. Of six nests under observation in 1938, floods destroyed two, and accumulated water from heavy rains came within 1½ feet of a third (nest 16). The following excerpt from the writer's field notes of May 3, 1938, emphasizes the importance of floods:

The prairie has been transformed into a miniature ocean dotted by tiny islands that previously had been the tops of knolls and ridges. On these islands sit wet and bedraggled prairie chickens and other birds that seem as confused and astounded as I by the sudden change in their environment. About a 5-inch depth of water covers the sites of nests 14 and 17, and former nest 15. Nest 16 has escaped by a hair's breadth, but the lining is very soggy. Problems due to hawks, skunks, and other predators seem so petty when excessive rain destroys virtually everything at a single stroke.

#### YOUNG

Although predators doubtless exert great pressure on the population of young prairie chickens in some areas, especially because the



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*Above*, Shells of eggs at prairie chicken nest destroyed by house cat; Colorado County, Tex., approximately 5 miles north of Eagle Lake, April 23, 1938. (Photo by Texas Game, Fish, and Oyster Commission; E. P. Haddon.) *Below*, Freshly killed prairie chicken recovered from a ferruginous rough-legged hawk; Colorado County, Tex., approximately 6 miles north of Eagle Lake, April 7, 1937. (Photo by V. W. Lehmann.)



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*Above*, Native bluestem prairie—well populated by prairie chickens; Colorado County, Tex., 6 miles northeast of Eagle Lake, December 21, 1936. *Below*, Prairie after plowing for rice—deserted by prairie chickens; Colorado County, Tex., approximately 5 miles north of Eagle Lake, March 7, 1938. (Photos by V. W. Lehmann.)

loose formation of the brood (see p. 19) and straying apparently induce mortality from this cause, definite information was difficult to obtain.

A female Krider's hawk caught a third-grown prairie chicken on May 24, 1937. From then on until June 9, when the male was collected, this hawk, assisted by her mate, hunted a section containing six broods. Most migrant raptors (roughlegs, redtails, and marsh and duck hawks) had left Colorado County prior to May 1, 1937, and April 15, 1938, before many young had hatched, and the resident species (red-shouldered, Cooper's, Sennett's white-tailed, and Krider's hawks) confined their activities largely to wooded areas. Because cover is dense in summer, and hawks are then uncommon, probably few young prairie chickens are taken in normal years.

House cats with freshly killed young prairie chickens were noted twice in 1937 and were seen stalking broods on three other occasions. Because of their numbers and predilections, house cats are thought to be exceedingly destructive.

#### ADULTS

Prairie chickens on the courtship grounds seemed more intent on mating than on self-preservation; consequently, losses from predation were probably heaviest at mating time. In Colorado County, during most of the 1937 and 1938 courtship seasons the abundant hawks harassed the prairie chickens persistently, sometimes with success. On April 8, 1937, 3 duck hawks, 7 marsh hawks, 2 roughlegs, 3 Krider's hawks, and 2 bald eagles kept the chicken population (about 45 birds) of the Everett pasture (640 acres) constantly moving. A freshly killed male prairie chicken (pl. 10) was taken from a ferruginous roughleg in that area on April 17. Marsh hawks, which Stoddard and others have found to be sometimes more beneficial than harmful to quail and other game, were especially annoying to courting birds, no other factor interfering with their activities to so great an extent. When a marsh hawk darted at one occupant of the booming ground, others generally cowered. The hawks pursued their intended victims for short distances, but soon returned and flushed others, or after dispersing the grouse, frequently alighted on the courtship grounds to await their return and resume the flushing tactics. On April 8, 1937, 4 marsh hawks concentrated on a single courtship ground and harassed the 6 male occupants from 5 to 7:30 p. m. Although no birds were killed, one lost many feathers when two hawks dived at it simultaneously.

By flushing prairie chickens, marsh hawks render them vulnerable to more efficient winged enemies, as duck hawks, goshawks, and the like. Waddell has seen duck hawks catch adult chickens on at least two occasions.

Mammals also take some of the birds on courtship areas. The stomach of a male house cat collected April 12, 1937, near a booming ground in the Everett pasture, Colorado County, contained the head, feet, and part of the breast of a freshly killed male prairie chicken. The remainder was found about 50 feet away.

A red wolf was suspected of killing a female prairie chicken on the nest, and either red wolves or dogs took three others in Colorado County in April 1937.

Only six instances of adult mortality were discovered that year, although intensive search for remains was made on foot and in cars over approximately 2,500 acres. In 1938, when none of the pastures were burned, no dead birds were found.

#### REVIEW OF NATURAL FACTORS

Natural factors limit the abundance of prairie chickens by destroying eggs, young, and adults and by reducing favorable territory. During the breeding season floods, storms, hail, drought, and excessive or persistent rains are known to be locally serious, the rains in May being most damaging. Drought has been associated with the only reported outbreak of disease that occurred in the Refugio area in 1917. The encroachment of brush on prairie land has transformed thousands of acres of what was once good prairie chicken range (pl. 11) into an unfavorable habitat. Although some predators harass the birds throughout the year, their effects are probably most serious at mating and nesting time. Natural mortality from climate and predators is severe in inferior or isolated cover.

The serious effects of natural factors are in every case either brought about or intensified by man's generally unwise treatment of natural factors. All except feral house cats and predatory dogs were operating against the prairie chickens, apparently without disastrous results, before the environment was radically modified by man. Since the unfavorable influences of natural agencies are due chiefly to man, it is encouraging to know that it is within his power and often decidedly advantageous to him so to modify his actions as to improve existing conditions and promote the welfare of the prairie chickens as well as his own.

#### ARTIFICIAL FACTORS

##### AGRICULTURE

Much of the best prairie chicken range has been recently appropriated for agricultural uses. More than 2,000,000 acres (table 14) were cultivated in 1936. In addition, thousands of acres of sod are plowed annually, with the extension of agriculture, especially rice farming. The acreage yearly planted to rice in coastal Texas in-

creased from approximately 174,500 acres in 1922 to more than 196,500 acres in 1937.<sup>5</sup> This latter acreage represents only a small part of the area actually depleted: rice farming has ruined more than 84,000 acres for the birds in Colorado County (pl. 11) alone, and probably in excess of a million acres in the State as a whole. Rice is hard on the land and most areas devoted to it can be profitably cultivated during only about 1 year in 4, after which they must be left fallow for about 3 years to "sweeten." Weedy rice fields ostensibly provide satisfactory grouse range; actually, however, they lack suitable courtship grounds and safe nesting cover, and, furthermore, the levees collect water that floods nests. Prairie chickens in fallow rice land apparently are doomed even though they are hunted lightly or not at all. According to Waddell, there were 10,000 of the birds on 30,000 acres of the Egypt section, Wharton County, in 1924. Rice farming began there in 1925, and by 1937 all the 30,000 acres were either in cultivation or fallow. Hunting pressure was reduced annually after 1925, and few, if any, birds were killed after 1935. In 1938, however, less than 150 prairie chickens remained. Prairie chicken decrease was also positively correlated with the expansion of rice farming in eastern Chambers and central Matagorda Counties. As additional acres of prairie are plowed, further decreases are certain to follow.

TABLE 14.—*Harvested and other crop land (1936) in counties partially or entirely within the probable former range of Attwater's prairie chicken in Texas*<sup>1</sup>

County	Harvested crop land	Other crop land	Total crop land	County	Harvested crop land	Other crop land	Total crop land
	<i>Acres</i>	<i>Acres</i>	<i>Acres</i>		<i>Acres</i>	<i>Acres</i>	<i>Acres</i>
Aransas.....	2,484	1,772	4,256	Kenedy.....	204	.....	204
Austin.....	105,396	11,313	116,709	Kleberg.....	28,639	7,211	35,850
Bee.....	92,247	20,685	112,932	Lavaca.....	158,604	10,652	169,256
Brazoria.....	98,045	17,787	115,832	Liberty.....	47,704	12,836	60,540
Calhoun.....	34,425	12,580	47,005	Matagorda.....	59,714	21,952	81,666
Cameron.....	130,684	32,483	163,167	Nueces.....	228,609	62,090	290,699
Chambers.....	16,772	5,727	22,499	Orange.....	8,245	1,334	9,579
Colorado.....	93,562	11,038	104,600	Refugio.....	40,147	16,183	56,330
DeWitt.....	153,307	30,843	184,150	San Patricio.....	165,691	35,769	201,460
Fort Bend.....	176,495	41,793	218,288	Victoria.....	100,300	17,828	118,128
Galveston.....	19,848	3,396	23,244	Waller.....	47,986	10,040	58,026
Goliad.....	64,374	12,711	77,085	Wharton.....	187,555	22,909	210,464
Harris.....	100,263	25,031	125,294	Willacy.....	60,981	10,001	70,982
Jackson.....	82,609	15,114	97,723				
Jefferson.....	44,205	12,386	56,591	Total.....	2,349,095	483,464	2,832,559

<sup>1</sup> Data from Texas Almanac and State Industrial Guide, pp. 231-236, The Dallas News, 1936.

#### PASTURE BURNING

Unregulated prairie fires intentionally set or of accidental origin have been, and still are, common in coastal Texas in every month of

<sup>5</sup> Figures supplied by David Wintermann, Relow Land Company, Eagle Lake, Tex., from data compiled by the Rice Milling Association.

the year. In Colorado and Austin Counties, for example, approximately 80 percent of the best prairie chicken country was burned over in 1936. A fire of accidental inception ran over about 3,000 acres of the 6,700 acre J. C. Anderson Estate ranch, Harris County, in May 1937. The cover on about 3,000 acres of the best prairie chicken country in Matagorda County was intentionally burned in July 1937. Pasture burning is an annual event on the Pipkin ranch, Jefferson County, fires being started during first new moon after February 15. Areas that the first fires do not cover cleanly are subsequently treated, and burning generally continues well through the nesting season. Most ranchmen, however, complete pasture burning by March.

The pastures are burned to remove old grass and encourage tender new growth more palatable to livestock. Fires usually are set when the grass is dry and the wind brisk, in order to finish the job quickly. The resulting fast, hot fires entirely denude areas except in low spots and deplete pastures of food, escape cover, and nesting sites. Prairie chickens and their natural enemies are crowded into unburned areas (pl. 12) and predation is undoubtedly intensified. During the breeding season fires destroy nests and probably many young birds as well; no fewer than nine nests with charred eggs were found by Waddell in a 640-acre pasture burned in May 1936. Plant life recovers slowly in the absence of abundant rain; consequently, fires accentuate the results of drought. Altogether, fire is one of the most important factors limiting prairie chicken numbers in pastures. When burning is carried on as outlined under Management (pp. 53 to 54), however, the evils are greatly reduced or entirely eliminated, and benefits accrue to forage and soil as well.

#### OVERGRAZING

With the possible exception of Orange and Jefferson Counties, overgrazing is severe in most of coastal Texas from late in fall through early spring. In addition to reducing cover and food for prairie chickens (pl. 12), overgrazing probably also increases the vulnerability of the birds both to natural enemies and to man. In Colorado County from 1936 through 1938, for example, it was noted that marsh hawks and other raptors harried chickens more persistently in lightly vegetated pastures than in areas where heavy grassy cover was present. Waddell observed that hunters regularly kill a higher percentage of known populations in areas where cover is light than where it is heavy. In Colorado County it has been found that the winter prairie chicken population of a pasture can be forecast with considerable accuracy by observing the extent to which the area is grazed. Large winter populations are rare in pastures where cover is short.



B49778, B60059

*Above*, Excellent unburned cover at right of road; inferior burned cover at left; Colorado County, Tex., approximately 7 miles north of Eagle Lake, December 22, 1936. *Below*, Scanty cover where there has been overgrazing; the shrub is Cherokee rose (*Rosa laevigata*); Colorado County, Tex., 6 miles north of Eagle Lake, March 7, 1938. (Photos by V. W. Lehmann.)



Aside from resulting unfavorably to prairie chickens, overgrazing in the gulf coastal country has been and is resulting in (1) the spread of undesirable brush and weeds, (2) the increase of needlegrass and other largely unpalatable grasses, and (3) serious erosion. An abundance of prairie chickens cannot be maintained on overgrazed tracts; it is equally impossible to maintain forage and soil on such areas.

#### OIL DEVELOPMENT

Oil development, which began with the discovery of the Spindle Top field in Jefferson County in 1901, has extended to every county in the coastal section. All the Attwater's prairie chicken area is classed as potential oil land, and almost every acre has been surveyed not once, but several times by oil crews. Veritable forests of oil derricks now stand in areas that once provided some of the finest prairie chicken range. In these areas, as in Fort Bend County, prairie chickens are almost, if not completely gone.

#### DRAINAGE

Drainage canals, as in Brazoria and certain other coastal counties, have in some instances improved the territory within a mile or so of their margins by providing a permanent water supply where it was otherwise lacking during the summer months. On the other hand, drainage canals have doubtless decreased the general wildlife productivity of the counties in which they are situated by speeding up the run-off and thus lowering the water table. Until recently many prairie ponds retained water throughout the year, produced crappie, bream, and other edible fish, held safe nesting cover for black mallards and other water birds, grew an abundant supply of food for wintering waterfowl, and served as concentration points for prairie chickens during the heat of summer. Now they go dry during the slightest drought and produce virtually nothing.

#### PASTURE MOWING

Regular mowing of grassy areas, mainly for hay or increased forage production, has promoted a nearly pure stand of grass in some of the areas treated and has reduced shade and food, and the general attractiveness of the areas for prairie chickens and certain other valuable wildlife. In Colorado County, areas that have been mowed regularly for long periods are virtually game deserts; prairie chickens use them little even at nesting time. Pasture mowing in coastal Texas appears to be extending rapidly, and further reduction in wildlife resources may be expected from this cause unless definite

modifications are effected. Fortunately, the detrimental effects of pasture mowing to upland game birds may be mitigated, at least to some extent, by following management recommendations listed on page 56.

#### MECHANICAL ACCIDENTS

Prairie chickens sometimes fly into telephone wires, fences, and houses, or are struck by automobiles. In six instances in 1937 birds were noted as accidentally killed in the Eagle Lake section—as many as were recorded for predation. Mortality from accidents may be far more serious than is generally appreciated.

#### HUNTING

Last, but not least, hunters certainly have contributed to prairie chicken decrease. Hunting has never been well regulated, and laws governing the taking of the birds have always been inadequate. According to the Texas Game, Fish, and Oyster Commission (Ann. Rept., 1929: 86-91) prairie chickens had no legal protection until 1883, when a 5-month closed season was declared during the breeding period. In 1885, 148 counties claimed partial or total exemption to this and other regulations, and it was not until 1903 that the legislature passed a bill designating the months of November, December, and January as the open season and setting a daily bag limit of 25. The legislation of 1903 was indeed a forward step, but there was no conservation body to enforce the measure, local officers being depended on to carry out its provisions. The Game, Fish, and Oyster Commission was not created until 1910, and for many years it was without adequate funds and personnel. As late as 1919 there were only 6 salaried wardens in Texas endeavoring to carry out, as best they might, almost wholly inadequate regulations. The law restricting the open season on prairie chickens to 4 days, September 1 to September 4, inclusive, and the bag limit to 10 a day or 10 a season, was not passed until 1929. In 1937 there were only 9 full-time wardens in all the Attwater's prairie chicken country, and they were charged with patrolling more than 8 million acres!

Development of the coastal territory, as farming, grazing, and the exploiting of oil, crowded prairie chickens into ever smaller areas, where they were more easily found and killed. The Hugthe-Coast Highway (State Highway No. 35) and various other roads increased patrol problems; the intercoastal canal in Galveston, Chambers, and Jefferson Counties made formerly remote areas easily accessible to poachers. The number of hunters increased as transportation facilities and weapons were improved. The open season in September, normally a dry period (see pp. 57 to 58), did much to

popularize hunting from automobiles. With these and other advantages, hunters evidently harvested too closely. In the Bernard River country (western Austin County and northeastern Colorado County), for example, it is known that in 1936 hunters killed 66 chickens, or 22 percent of the estimated total population (300). This was accomplished despite the fact that the gunners were closely supervised and did not hunt in the most densely populated pastures. It is probable that excessive kills have occurred in other areas for many years; the 1937 census showed that Attwater's prairie chickens were nearly or completely extirpated except on or adjoining lands where they had been hunted little, if at all, for at least 10 years. In Harris, Galveston, Waller, and possibly in parts of other counties, hunting has probably been the agency most largely responsible for prairie chicken decline.

### MANAGEMENT

Leopold (1931: 3) has defined game management as the art of making land produce annual crops of wild game for recreational use. In coastal Texas, the management of prairie chickens must consist largely of the preservation of suitable grassland areas. Increased protection, habitat improvement, adequate predator control, and proper regulation of the harvest, however, will greatly encourage recovery.

### PROTECTION

An act (H. B. 30) passed by the State legislature, effective September 24, 1937, forbade the killing of prairie chickens in Texas for a period of 5 years. This measure removes much of the pressure previously exerted on the birds during the regular open hunting season, for true sportsmen will observe the decree. Landowners, game wardens, and other interested individuals, however, will remember that close seasons may tend to stimulate rather than retard the operations of game bootleggers. According to the consensus of State game wardens in the coastal territory, violators are especially active (1) during the birds' spring courtship season when the conspicuous males, their instincts of self preservation dulled by the the mating urge, are easy targets for .22-caliber rifles; (2) late in July and August, when the tame young birds are of "frying" size; and (3) during the duck season, when whirring flocks of Attwater's prairie chickens evidently tempt gunners who have insufficient self control. Coastal game wardens report that, in years past, probably as many prairie chickens were illegally killed during the duck season as were taken legally during the then open season in September. The restoration of the species demands close protection for the remaining birds at all times.

Although game wardens in the prairie chicken country are sincere and energetic, the territory is too vast for adequate protection under the facilities available. Sportsmen may render valuable aid by helping conservation officers apprehend irresponsible hunters, but landowners or their resident agents must handle the job if prairie chickens are to receive anything like adequate protection. Landowners, individually or in groups, would do well to incorporate their holdings to form game-management areas, as advocated by the Extension Service, Texas Agricultural and Mechanical College and the Texas, Game, Fish, and Oyster Commission. Under that plan, increased protection is provided through appropriate posting and provision by the landowners of qualified, resident, free-service State game wardens. Also technical service is given in solving predator problems, improving wildlife food and cover, properly regulating harvests, and otherwise maintaining wildlife crops. Nonresident owners should check up on the manner in which their foremen or lessees protect wildlife during their absence. It is regrettably true that some supposedly protected ranches are in reality hunting clubs for irresponsible agents and their friends when the landowners are away. Long-time lessees who wish to manage prairie chickens or other game should insist that their contract include control over the wildlife resources of the property as well as over grazing or other values. These lessees may thus avoid embarrassment from unwelcome hunter guests directed to the area by the absentee owners.

Landowners who contemplate leasing their holdings for oil development might well follow the precedent set by a ranch owner in Refugio County. Each of his contracts carries the provision that the lease shall terminate immediately after any representative of the contracting company is caught on the property with a gun of any kind. Such a clause properly shifts the burden of supervising irresponsible oil workers from the landowner to the oil company.

Increased protection of the few remaining Attwater's prairie chickens is necessary for success in management. Protection alone, however, is largely ineffective in areas where proper food and cover conditions are lacking.

#### HABITAT IMPROVEMENT

At present there are few areas in Texas where excellent conditions for prairie chickens prevail, and populations fluctuate markedly (table 15). Increase or decrease in study areas was thought frequently to coincide with fluctuations in the supplies of food, cover, or surface water. In many areas marked seasonal movements may be averted and larger and more stable populations maintained by removing deficiencies in habitat.

TABLE 15.—*Fluctuations in numbers of prairie chickens, Thomas and Koy pastures, Colorado County, 1937*

Pasture	Size	Prairie chickens found							
		Feb. 22 <sup>1</sup>	Apr. 13	May 2	June 2, 8, 10	July 26	Sept. 1	Oct. 22	Nov. 1
	Acres	Number	Number	Number	Number	Number	Number	Number	Number
Thomas.....	817	31	30	28	37 16	0	17	0	1
Koy.....	460	0	0	0	14	23	32	0	0

<sup>1</sup> Count of birds at or near the courtship grounds; no allowance made for any birds that may have been missed. All other counts were by the rope method. (See p. 49.)

## EVALUATING CONDITIONS

In some instances it is relatively easy to point out one or more ways in which areas are inferior. Safe nesting cover is deficient in burned pastures that are devoid of old vegetation except in low damp places. Shade is insufficient on lands kept free of tall weeds or shrubs by mowing or grazing. Winter food, or cover, or both are usually lacking in areas having few native food-cover plants, as ragweed, goatweed (*Croton*), marsh-elder, or ruellia. Sometimes, however, habitat deficiencies are obscure and general observations of an infrequent nature do not identify them. Accurate inventories are of assistance in determining (1) whether habitat improvement is needed, (2) what should be done, (3) results of work done, and (4) the surplus available for hunting. Management programs should be formulated on the basis of data obtained during inventories conducted thrice annually, in spring, summer, and winter. Inventory methods, recording and interpreting data, and management practices are discussed in the following paragraphs.

## CENSUS METHODS

## SPRING COUNT ON THE COURTSHIP GROUNDS

The first census method that has been tried and found useful is the spring count of birds on the courtship grounds. Necessary are an automobile, preferably of light build and high clearance, a driver who is well acquainted with the area, and someone to act as observer, note keeper, and gate opener.

A count is made on each courtship ground in the area, recording the number and sex of birds assembled there and the number and sex of birds seen between these grounds. The number of hens is recorded as a supplementary check. The number of males, increased 80 to 110 percent to allow for females that will be missed is accepted as the total population of the census area. For best results, the

spring count is made in March from daybreak to about 7:30 a. m. A population estimate based on the maximum count obtained by reworking the same area three successive mornings, or often enough to offset variations due to unfavorable weather, is likely to be sufficiently accurate. Where recounts are impracticable, the single enumeration should be made on a clear, quiet morning after a brisk norther.

Courtship grounds may be located by sight or sound of the birds assembled there, but it is preferable to "drive out" the census area in belts 150 yards or less wide. Drumming grounds should not be approached more closely than is necessary, because flushing the birds leads to inaccurate counts. As birds frequently squat, or freeze, at the approach of a car, it is desirable to wait at each occupied booming ground and refrain from counting until after vigorous courtship activity has been resumed. It is good policy to encircle a counted area completely before proceeding to a new site, for the fresh car tracks often assist in avoiding duplication.

The accuracy of spring counts on the courtship grounds was tested in the following ways: (1) A section (640 acres) was covered on 10 successive mornings; (2) a 1,000-acre pasture was searched with the aid of 15 bird dogs; (3) a 1,000-acre pasture was recounted by 5 men using 2 cars, 3 horses, and 2 dogs; (4) a section worked 3 successive days was rope counted. Spring counts have been made over approximately 150,000 acres in Colorado, Wharton, and Austin Counties. These studies show that the enumeration of birds on the courtship grounds is the most rapid and economical of all known census techniques. More than 2,000 acres a morning have often been covered in areas having populations of about 1 bird per 45 acres. There are no indications that the method affects courtship activities adversely or that it greatly endangers early nesting. Also, the spring count of males is useful in yielding data on prairie chicken abundance in comparable areas worked at nearly the same time and under nearly the same conditions.

The spring count of birds on the courtship grounds, however, is not without its defects. Its accuracy is influenced by weather and other conditions at a time convenient for counting. Opportunity is limited to a few hours a day (from about 6 to 7:30 a. m.) over a short period (in March). The spring count does not reveal the number of females present, consequently, it does not produce reliable quantitative data on sex ratio and total population. Some observers experience difficulty in distinguishing males from females, especially in the poor light of early morning. To them the analysis of sex differences, presented on p. 49, may be helpful.



B48329; B48979

*Above*, Rope counting of prairie chickens on Matagorda Island, Tex., October 30, 1937. *Below*, Rope counting in myrtle brush; Liberty County, Tex., approximately 8 miles southeast of Devers, June 27, 1937. (Photos by W. P. Taylor.)



## FIELD BASIS FOR DIFFERENTIATION OF THE SEXES IN SPRING

<i>Basis</i>	<i>Males</i>	<i>Females</i>
General color-----	Light gray-----	Brownish gray.
Color of breast-----	Not perceptibly different from that of back.	Much lighter than that of back; appears almost white in flight.
Barring on back and breast.	Heavy, black, well defined..	Light, brownish black, poorly defined.
Color of head-----	Orange-colored comblike structure present above each eye.	Orange-colored combs absent.
Feathers of crest-----	Seldom erect-----	Frequently erect.
Neck-----	Appears thick and heavy, with large, brightly colored (orange) air sac apparent on each side of neck under prominent (2.25 to 2.90 inches) neck tufts.	Appears thin and long; air sac and neck tufts rudimentary ( $\frac{3}{16}$ inch long).
Size-----	Large, heavy (about 2 $\frac{1}{4}$ lb.)	Small, light (about 1 $\frac{1}{2}$ lb.).
Action on courtship grounds.	Bold, struts, fights, and booms in open cover.	Shy, does not strut, fight, or boom.
Flocking-----	Usually in groups of 8 to 12 when booming, feeding, or resting at midday.	Usually alone.
Flushing-----	Laborious take-off; cackles when rising from ground.	Easy take-off; usually does not cackle.

## THE ROPE COUNT

A second method of counting, one that has been tested with most encouraging results in the coastal prairie chicken country, is the rope count (pl. 13). Essential equipment includes two automobiles, preferably of light build and high clearance, an inch rope or a quarter-inch flexible steel cable 60 to 120 yards in length, and two strong swivels. An extra supply of water for radiators is needed in hot weather as cars heat up under the heavy going. In addition to drivers for the two cars, a third person should be taken along, if possible, to act as note keeper and general handy man.

When the census area is reached, one swivel is attached to the right end of the rear bumper of the car in which the note keeper is to ride, and the second swivel is attached to the left end of the rear bumper of the other machine. Each end of the rope or cable is then securely tied to a swivel. Care must be exercised to see that the rope or cable, in turning, will tighten its twist and not loosen or unravel. One machine takes position parallel to a fence or other definite landmark while the other goes far enough way to stretch the rope so that only a slight bend remains. After both cars are in position, they drive over parallel courses at a uniform speed of 5

to 15 miles an hour, which may be increased in light cover but which should be reduced in heavy vegetation to keep the rope, for the greater part of its length, about 5 inches above ground. Birds are tabulated as they are flushed. Those flying into uncovered territory are deducted when that area is dragged. When the end of a strip is reached, the car in which the note keeper rides turns and

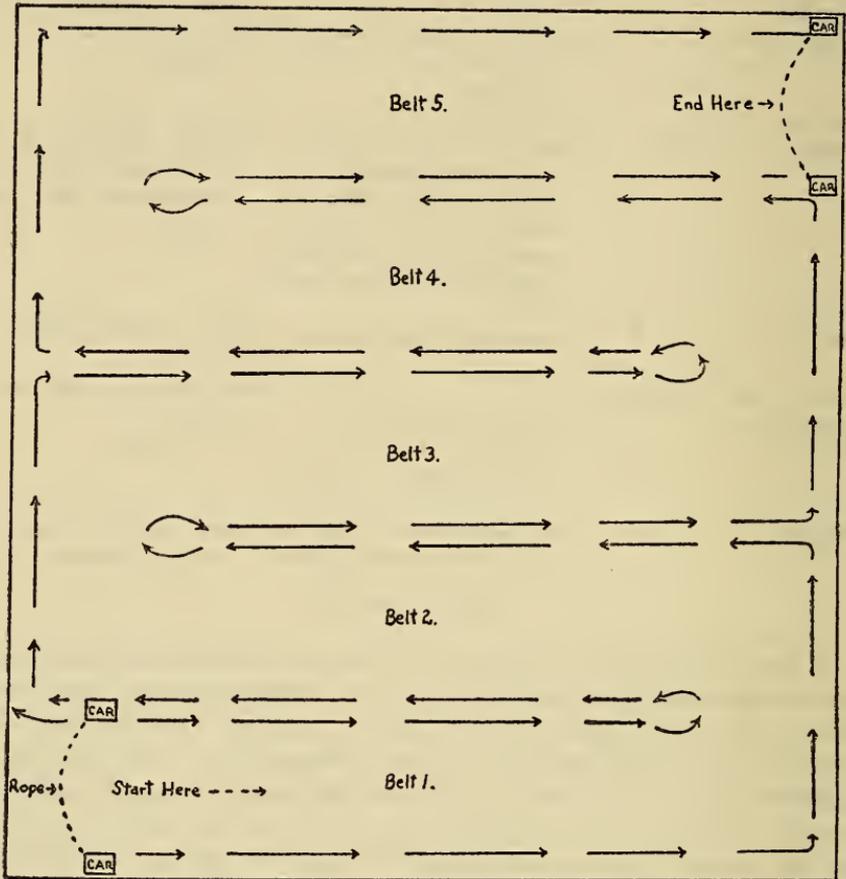


FIGURE 4.—Diagram of the rope count. Arrows show course of each car.

retraces its course while the other car makes a wide swing to the outside margin of another belt (fig. 4). This is repeated until every part of the census area has been covered.

The principle of rope counting is not new. Askins (1931: 8) reports that market hunters and others in Kansas “\* \* \* hitched a wire between two wagons and with these driving across the prairie 300 yards apart, the gunners walked behind the wire taking the grouse as they arose until the wagon was filled.” Butchers of wild-

life (they have no claim to the title of sportsmen) have used modifications of this system in coastal Texas for years.

The rope census method has been checked and rechecked for accuracy against the spring counts of birds on the drumming grounds, car counts, and counts with bird dogs. The rope count, by far the most efficient of all, has been tried over approximately 45,000 acres of grouse range, including every major prairie type in which Attwater's prairie chickens occur in Texas. Heavy myrtle brush, as in Jefferson, Liberty, and other counties east of the Brazos River, light to heavy *Paspalum-Andropogon* grassland as in Brazoria and Colorado Counties, live oak shinnery in the northern part of Victoria County, rough weedy hog wallow blackland of Refugio County, and even the extremely rough salt-grass area of the same section, have all been negotiated successfully. These tests have demonstrated clearly the practicability of the rope count under all coastal prairie conditions. Another advantage is speed; a party can easily cover 2,000 acres a day; Waddell and the writer having counted the birds on an area of this size in one morning.

Ropes last for a considerable period, one that has been dragged over 20,000 acres still being used. This method of counting is not closely limited to a short season, or to a particular part of the day, as is the spring count on the courtship grounds. The accuracy of the rope count is not dependent on special weather conditions or on other variables over which man has no control, its major advantage lying in the fact that, when properly used, it gives an accurate quantitative count in the census area. For that reason, it is most useful in prairie chicken management.

The rope count is dangerous for the layman to use during the nesting season and when young birds are small (during the latter part of March through June), for unless extreme care is taken, nests may be broken up and young birds injured, scattered, or even killed by a fast-moving, 1-inch rope. A  $\frac{1}{4}$ -inch rope, 50 yards long, however, has been used with success in locating nests and broods without detriment to the birds. Coffee-bean plants, yaupon bushes, trees, and old fence posts are obstacles to rope counting, but they can be avoided without great loss of time, and, with care, few breaks in the rope or cable result. Of course, cultivated fields cannot be traversed without injury to standing crops, and counting is difficult and sometimes impossible in fallow rice fields where levees are high. Inexperienced persons sometimes have trouble in keeping the proper amount of slack in the rope and in following the car tracks which are depended upon to mark the inside margin of every new belt. These minor difficulties, however, are rapidly overcome by practice.

## CAR-DOG COUNT

A car-dog count is made by driving out an area in belts 40 to 150 yards wide and releasing dogs to work the area where birds are known or strongly suspected to be. Necessary equipment consists of one car and one well-trained dog, but two cars, with a man and two dogs in each, speed up the work more than 100 percent.

Since 1936 this method has been employed in working over 25,000 acres. It is economical and is highly enjoyable to dog lovers, but it is slow. The work of different dogs and that of the same dog at different times and under different conditions varies greatly. Duplications in counts or recounts are virtually unavoidable on well-populated range, and misses are frequent. As reliable data are difficult to obtain by this method, it should be used only when other census techniques are impossible.

## USING THE CENSUS

Censuses produce the most dependable information when applied over an entire management area. Where this is impracticable and sampling is resorted to, care must be taken to insure that the selected area is typical with respect to vegetation, topography, water, and the like, and is sufficiently large. In a pasture consisting of 60 percent flat grassland with little or no brush and 40 percent sandhills covered with live oak shinnery it would be incorrect to sample only the sand-hill territory and apply the findings to the flat grassland as well. Sampling should be divided proportionately between distinct environmental types. Sample areas should be at least a section, or 640 acres, in size, and they should preferably cover 2,000 acres. Thoroughness should never be sacrificed for extent of coverage, however, as accurate censuses made thrice annually on a well-chosen section over a period of several years will yield infinitely more usable data than will haphazard counts sporadically undertaken over more territory than can be conveniently handled.

During the spring census, investigators should list (1) males, (2) females, (3) occupied courtship grounds and the number of males at each, (4) unoccupied courtship grounds, and (5) jack rabbits, in areas where they are a common resident species, as in the country west of the Brazos River. Census sheets should show also (1) name of the pasture, (2) name of owner, (3) size of sample area, (4) exact location, (5) date of census, (6) counting method used, (7) weather, and (8) names of the investigators. Additional notes taken should describe (1) the type of country censused, whether flat grassland with few weeds, rolling country with scattered myrtle bushes, and so on; (2) grazing pressure, whether light, medium, or heavy; and (3) recent burns on high or low ground, showing the percentage of area burned, whether

burn is general or spotty, and the location of unburned cover. Careful compilation of data greatly facilitates accurate interpretation.

If prairie chickens are numerous in the sample area, 1 to every 10 acres or less, cover conditions should not be changed. Instead, steps should be taken to insure that grazing and burning practices will duplicate the conditions in future years. If the birds are scarce, less than 1 to every 10 acres, and if they have not been overshot, habitat deficiencies should be sought and corrected.

#### SPRING

Probable habitat deficiencies limiting prairie chicken numbers in spring are scanty, poorly distributed, or overdense nesting cover and a shortage of suitable courtship grounds. Common causes of deficient cover are general burning and overgrazing that result in scarcity or complete absence over more than 60 percent of the area of old vegetation, left from previous years at an average height of at least 5 inches, and poorly distributed cover confined to a particular part of a pasture or to low, poorly drained situations. Undergrazing is the usual cause of overdense cover, the thick matted vegetation that chickens regularly avoid. Where jack rabbits (Taylor, Vorhies, and Lister, 1935) are a common resident species, they are usually either very numerous, 1 to every 10 acres or less, or entirely absent where cover is too scanty or too poorly distributed to be suitable for nesting prairie chickens. Jack rabbits are frequently scarce, 1 to every 80 acres or more, however, in cover that is overdense. A markedly unbalanced sex ratio, with more than twice as many male prairie chickens as hens, also has been noted in pastures where nesting cover was deficient.

In areas in which the cover is scarce because of general burning, conditions are improved by leaving 40 percent or more of the grassy cover unburned each year. Unburned cover should be well distributed over the pasture, the greater part being on the highest, best-drained ground, in patches of 5 to 40 acres. Favorable conditions are encouraged if burning is carried on when there is little or no wind and the vegetation is slightly damp. A quiet day following a light shower, or a still night after the dew has begun to fall, is preferable. A test fire should be set in a protected corner of the pasture. If it burns slowly, consuming only the most combustible material, and dies down in 5 to 15 minutes, a series of fires then may be set throughout the pasture. The number should be strictly regulated by the acreage to be burned and the manpower available to curb the fires in case of such unforeseen difficulties as a fresh breeze that may put fires out of control. The best insurance against trouble from that cause is a plowed fire lane, 5 to 10 feet wide, completely encircling the pasture and

dividing it into blocks of approximately 100 acres each. All pasture burning should be completed by December or early in January, well in advance of the nesting season.

Moderation in grazing is important. Cattle should not be left to graze on a tract until unpalatable bunch grasses, as smut grass, salt grass, big bluestem, and the like, are all that remain. Ideal conditions are approached when the number of animal units is strictly regulated according to the quantity and quality of the available forage. This practice avoids a condition of cover that is scanty in dry years and overdense in wet years, and, besides being favorable to prairie chickens, it conserves the soil and the range.

A shortage of courtship grounds, short-grass areas from one-half to 10 acres in extent surrounded by light to medium-heavy grassy cover, is frequently indicated by an unbalanced sex ratio with more than twice as many females as males or by a preponderant male population of 8 to 15 or more birds on each booming ground. Common causes of inadequate courtship facilities are (1) a lack of hardpan flats; (2) general burning, which denudes vegetation over a wide area and causes prairie chickens to leave; and (3) undergrazing, resulting in tall cover even on hardpan areas. These deficiencies, however, are remedied by spot burning and moderate grazing.

#### SUMMER

Probable deficiencies that limit the number of birds in summer are an insufficient supply of water in dry years and inadequate shade. A count made from July 1 through August 10, preferably over the same area covered in spring, reveals the number of young produced, and thus serves as a check on the success or failure of the breeding season.

The data recorded for the summer count should be the same as for the spring count and, also, investigators should note (1) the number of young, (2) the number, character, and location of water supplies, and (3) distribution of birds with respect to water and weedy cover.

A larger population of adult prairie chickens than was found in spring shows either that the spring census was inaccurate, or that other birds have moved in. In the latter event no habitat manipulation should be attempted unless the resident population plus the influx averages less than 1 bird for every 10 acres, and a larger population is desired. If the adult population has decreased since spring, however, and it is established that poaching has not occurred, the census data should be examined for information suggesting causes of the decline.

Indications of deficient water are the absence of watering places a mile or less apart, and the concentration of birds and jack rabbits in parts of the area where water is available. Indications of deficient

shade are the scarcity of prairie chickens and jack rabbits where surface water obtains. Ordinary causes of insufficient water are drainage and unusually dry seasons. Water supplies can be improved by cleaning and deepening natural ponds or constructing new ones, and allowing windmill pumps to spill over and maintain puddles nearby.

Common causes of inferior shade are heavy grazing and mowing. Shade deficiencies usually can be corrected naturally by moderate grazing and leaving unmowed plots 1 to 10 acres in extent in flats near ponds. Other methods of obtaining and maintaining tall shading cover are by (1) fencing tracts from  $\frac{1}{2}$  to 10 acres in size within 100 yards of water holes and leaving the fenced areas ungrazed; (2) planting tamarisk, chinaberry, black locust, elm, sycamore, cottonwood, or other adapted trees near water supplies; (3) constructing two or more brush racks 5 by 6 by 2 feet high on knolls on high ground near ponds; and (4) strip plowing near ponds as outlined on page 56.

An increase of 100 percent in the number of prairie chickens in any year is excellent. An increase of 50 percent or less may indicate either a poor breeding season or abnormally high predation. Rainfall records for May show whether breeding conditions are poor; in the event heavy rainfall is not the causative agent, predators may be responsible. In the latter instance, the number of predatory dogs and house cats should be reduced by shooting or trapping. If a thorough job is done and yet the increase is small, the aid of State or Federal wildlife technicians should be solicited.

#### WINTER

In winter, a grouse habitat may be deficient in food, cover, or both. This may best be determined by study of information obtained during a December or early January reconnaissance of territory that was covered in summer. Except for the data on the number of young birds and on the water supply, information recorded in winter should be the same as that in summer, and it should show whether birds are generally distributed or heavily concentrated in small areas. The rope count is the preferred method of winter census, dog counts being made only when rope counting is impracticable.

Assuming that poaching is not a factor, a winter population larger than that of the summer, shows habitat conditions on a census area already more favorable than those in pastures nearby and suggests that management be directed at maintenance, rather than at alteration of environment. A winter population smaller than that of the summer suggests food or cover deficiencies. Other indicators of such inadequacies, generally occurring together in heavily grazed areas, are a prevalence of largely unpalatable plants, as goatweed, marsh-elder, dogfennel, perennial ragweed, smutgrass (*Sporobolus poiretii*), and

cordgrass; a concentration of prairie chickens in small parts of the area; and an abundance of jack rabbits (averaging 1 to every 10 acres or less), or their complete absence. Indications that food only is lacking are a uniform growth of heavily matted grass, a sparse growth of weeds, and a scarcity of jack rabbits (averaging 1 to every 80 acres or more). Moderate grazing encourages favorable food and cover conditions.

To make up for local shortcomings, prairie chicken managers may establish (1) stockproof-fenced areas of  $\frac{1}{2}$  to 10 acres in as large numbers as practicable; (2) plowed strips 20 to 50 feet wide dividing sparsely inhabited parts of pastures into blocks of 50 to 200 acres; and (3) unmowed patches of cover of 2 to 10 acres or more, situated not more than 300 yards apart. Fenced areas should not be grazed, and, if possible, half of each fenced area should be planted annually to Schrock, German millet, dwarf milo, hegari (pl. 14), or red-top cane. Brush racks built in the corners of fenced areas attract quails as well as prairie chickens. In average years strip plowing may be done with satisfactory results from December through April, but February is considered most favorable. The best effects on experimental areas in Wharton County and at College Station have been obtained on strips that were plowed shortly before or after a rain and harrowed immediately after the preliminary breaking. Unmowed patches of cover should be left on knolls or ridges, in flats around ponds, or in other places where sizable stands of weeds occur.

#### GENERAL RECOMMENDATIONS FOR HABITAT CONTROL

Landowners who do not undertake intensive management of prairie chickens based on counts made three times a year may adopt any or all of the following general recommendations with the assurance that some improvement will result:

Pastures should be grazed moderately by livestock.

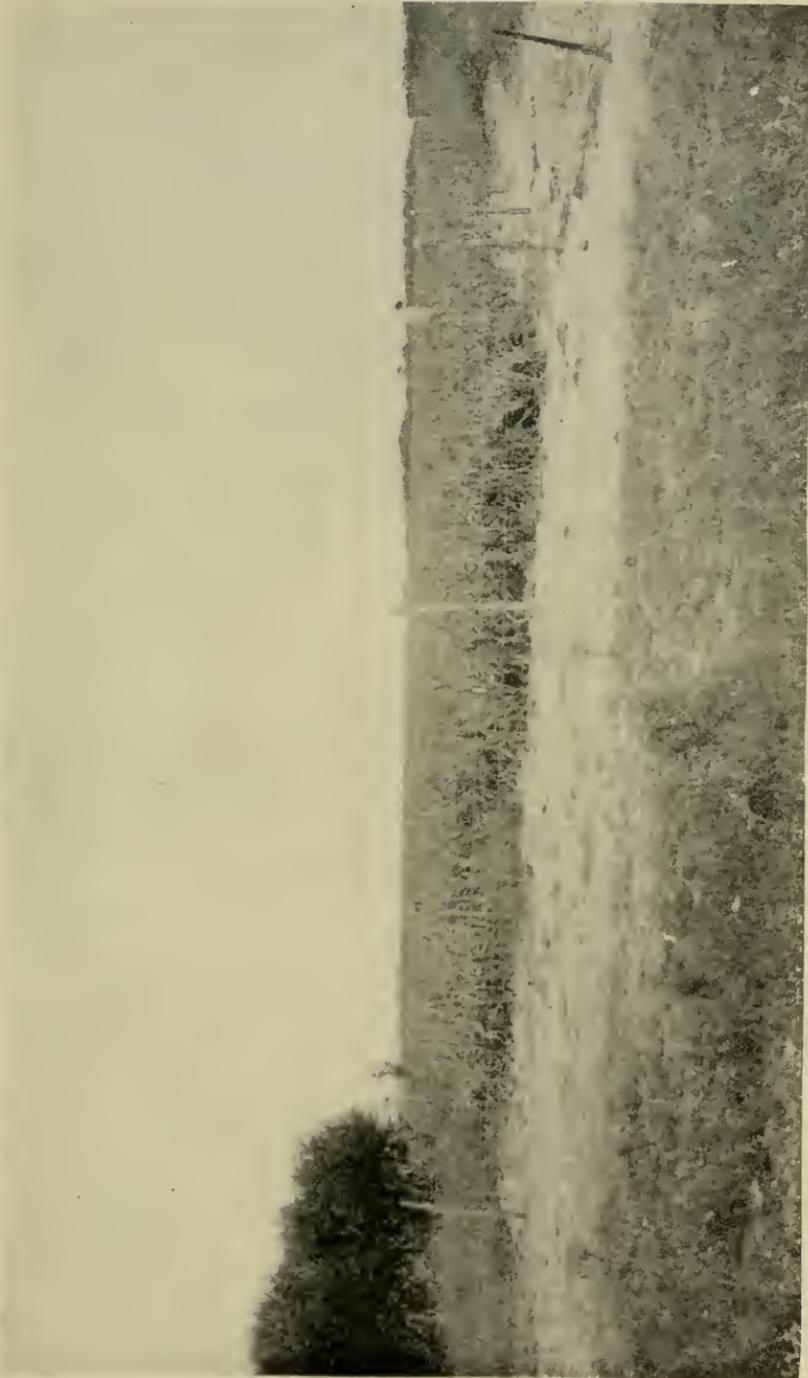
Pasture burning should be completed before February 1; in excess of 40 percent of the pasture should be left unburned, with the remaining cover well distributed in patches of 5 to 40 acres on the best drained areas.

Mowing should not be done before July 1; unmowed patches of 2 to 5 acres or more, not more than 300 yards apart should be left on flats, knolls, or in other places where there is a good stand of weeds.

In summer windmill pumps should be allowed to form puddles.

Predatory house cats and dogs should be rigidly controlled.

The present 5-year close season (effective September 1937) should be enforced. If and when the season is reopened, not more than 35 percent of the known population should be shot when rainfall in May is normal or less. In years when rainfall in May is approximately twice normal, no birds should be killed.



E49339

Fenced plot planted to hegari; Wharton County, Tex., approximately 9 miles south of El Campo, November 1, 1937. (Photo by W. P. Taylor.)



## PREDATOR CONTROL

Exhaustive studies by McAtee (1931, 1932, 1935, 1936), McAtee and Stoddard (1930), Fisher (1893)), May (1935), and others have demonstrated rather conclusively that the food of most flesh-eating birds and mammals is determined mainly by the availability of prey. Errington (1935) adds that predation is largely confined to insecure or surplus populations; in areas where there is adequate food and cover, hawks, owls, skunks, opossums, and the like feed principally on the more common rats, mice, snakes, frogs, and insects, rather than on the less numerous, swift, and elusive game birds. Flesh eaters often are neutral, and may be actually beneficial, in relation to sport and agriculture. Specific data presented on the relationships of Attwater's prairie chicken and its natural enemies (pp. 37 to 40) are by no means so comprehensive as desired. The information at hand, however, apparently justifies the following general recommendations concerning predator control on prairie chicken range:

Feral house cats and predatory dogs may well be controlled.

Hawks, owls, and fur animals should not be killed indiscriminately, their control being limited to known offenders. Inhumane pole traps should not be used. (All raptorial birds except Cooper's, sharp-shinned, and duck hawks, goshawks, and great horned owls are protected in Texas.)

Fur animals should be taken only during open seasons when furs are prime, and the harvest should be regulated to promote sustained yields.

## HARVESTING THE SURPLUS

Former laws governing the shooting of Attwater's prairie chickens left much to be desired. Regulations in effect from 1925 through 1937, providing an open season from September 1 through September 4 and a bag limit of 10 birds a day or 10 a season, actually stimulated butchery and injured sport. Hunting was allowed when birds were easily found, many being concentrated near patches of heavy cover near surface water. Unwary young of the year were easily shot because they flushed near the gunner, flew straight and slowly for short distances, and ran but little after alighting. Adults performed similarly, probably because the weather was warm, the cover dense, and because they were in molt. September heat prohibited efficient work by bird dogs, so crippling losses were doubtless high. As it was also uncomfortably warm for men to walk, hunting by cars, and shooting from them, in violation of State law, became the rule in Colorado and Austin Counties and probably elsewhere in coastal Texas.

In the future, the power of making regulations might well be delegated, under proper safeguards, to the State Game, Fish, and Oyster Commission, which has the benefit of information and counsel

from its own trained game protectors and from experienced sportsmen, as well as from wildlife specialists connected with the State and Federal Governments. This power should allow for prompt modification of regulations in response to emergencies of climate, or other conditions affecting the welfare of the birds. The proper open season on Attwater's prairie chickens, assuming that the numbers of the birds can be built up to withstand the drain of shooting, cannot always be determined in advance, and regulations should be formulated in accordance with local conditions as they develop. The State legislature, meeting only at 2-year intervals, must rely on the State Game Commission for appropriate regulation of the take of game; and only under that arrangement can the people properly hold the Commission fully responsible for game protection.

If hunting is again allowed, seasons should not in any case open prior to November 15. Weather late in November is usually sufficiently cool for the comfort of men and dogs, and, normally, the prairies are too wet to allow hunting from cars. The prairie chickens, already congregating in winter packs, are widely distributed and strong flying; consequently, they are hard to find and even more difficult to hit. Probably because the young of the year are strong and more worldly wise, and because the weather is cool and the ground cover reduced, late fall birds regularly flush widely, twist crazily, fly swiftly and far, usually for a mile or more, and run after alighting. In other words the Attwater's prairie chicken in November is a game bird of the highest order; hunting it thoroughly tests the most skillful hunter and the best bird dog. That is as it should be in true sport.

#### RESTOCKING

At present the possibility that prairie chickens may be restored by artificial planting is remote, as wild birds are not available for trapping and moving, and artificial propagation has shown little promise. Furthermore, there is no assurance that prairie chickens, if available, would survive if moved. In Texas and Oklahoma, attempts to transplant lesser prairie chickens have been unsuccessful. Bent (1932: 263) records the failure of numerous attempts to transplant the greater prairie chicken in northern States. A number of these birds introduced in the vicinity of the Sault Sainte Marie and McMillan in northern Michigan persisted for a few years, but F. F. Tubbs, Michigan Department of Conservation, writes that they have disappeared. It is true that no intensive efforts have been made to transplant Attwater's prairie chickens in southern Texas, but there is no reason to believe that they would survive the process better than have their relatives.

Natural restocking, however, takes place rapidly and efficiently when prairie chickens are properly protected and allowed to increase. Since 1935 practically all suitable territory in Refugio County has been restocked by natural spread from the Salt Creek Ranch and the properties of Martin O'Conner. When the birds are permitted to increase elsewhere, similar results may be expected.

#### SUMMARY

Attwater's prairie chicken, a characteristic bird of the coastal prairie, is one of three kinds that once occurred in Texas. A few lesser prairie chickens, smaller and paler in color than Attwater's subspecies, still persist in parts of the Texas Panhandle. The greater prairie chicken, however, has been entirely extirpated from its former habitat in the central and northern parts of the State.

An intensive census made in the summer of 1937 revealed that only about 8,000 to 9,000 Attwater's prairie chickens then remained in Texas, approximately half of them being in Refugio County. The birds now inhabit only about 450,000 acres, compared with the more than 6,000,000 formerly occupied. The numbers of the coastal prairie chicken have declined 99 percent, and its range has decreased more than 93 percent during the past century.

The mating season begins late in January or early in February, when the males assemble on short-grass areas early in the morning and late in the afternoon and boom and otherwise display the mating urge. Females are attracted to the courtship areas by this activity, and mating usually takes place there. Prairie chickens are promiscuous. The booming is at a climax in March and ends late in May.

Nests containing eggs have been found from February 25 through June 17. The peak of the laying period, however, is late in March and in April. Females build their nests in dry vegetation of the previous year preferred nesting sites being in good cover in well-drained areas and within 5 yards of an opening.

The normal rate of laying is 1 egg a day until the average clutch of 12 is completed, but intervals of 1, 2, and even 3 days are not infrequent. Subsequent attempts to nest may be made if earlier nestings are terminated while booming is still in progress. Second and third nests apparently are made in close proximity to those previously destroyed, which probably jeopardizes their chances for successful termination. The incubation period is 23 to 24 days and hatching occupies about 2 days more. The peak of the hatching season is in May. Fertility of the eggs evidently is high. Nest losses in 1937, however, were 70 percent of 13 nests studied, and those in 1938 amounted to 67 percent of 6 nests.

In 1937, of broods on which accurate counts were obtained, 48 averaged 5.48 birds each. Mortality of young prairie chickens is highest (about 50 percent) in the first 4 weeks after hatching and comparatively low (about 12 percent) thereafter, a large share of the early mortality being in lost chicks. Other known causes of juvenile mortality include heavy or persistent rains during the brooding, drowning in rice fields, and depredations by natural enemies. Family disintegration, although gradual, begins when the chicks are 6 to 8 weeks old. It is completed after cold northers late in October and in November induce fall flocking, or segregation of the birds into flocks according to sex.

Unstable and temporary groups of 5 to 15 birds are common from September through early October, but singles, pairs, and trios predominate at that season. As fall passes into winter, flocks become larger, and in December and January groups containing 35 to 300 individuals have been observed. Singles, pairs, and trios, however, may be found throughout the year.

Young prairie chickens evidently spend their first 3 weeks within half a mile of the spot where hatched. Late in May and in June, both young and adults move to territory where cover providing good shade is found within half a mile of surface water, there to remain usually until September. When fall rains and cool weather come and the fall weeds mature, the birds scatter widely, often becoming common where scarce or entirely absent at other seasons. Concentration into areas where there is moderate-to-heavy cover and adequate food is evident by November, and populations in favorable areas fluctuate little from then through spring.

The food of adult prairie chickens is about 85 percent vegetable matter and 15 percent animal. With young birds the ratio of vegetable to animal is approximately reversed. Favorite sources of plant food are ruellia, perennial ragweed, blackberry, doveweed, and sensitive briar. Leading animal foods are grasshoppers and beetles. Greens (leaves, flowers, buds) are lowest in the diet in November and December; seeds are taken in the smallest proportions in January, February, and March. Insects are least frequently captured in November, December, and January.

Important factors limiting prairie chicken abundance include excessive or persistent rainfall during the nesting season, heavy grazing, excessive pasture burning, agricultural operations, and overshooting. Other destructive factors, not generally serious but sometimes locally disastrous, include oil development, drainage, floods, drought, hurricanes, hail, the spread of woody vegetation into prairie land, predation, pasture mowing, and possibly disease.

Available records from 1925 through 1937 show a positive correlation on unmanaged land between the production of young prairie chickens and rainfall in May. Good crops of young chickens are brought off in years when the rainfall in May is  $1\frac{1}{2}$  inches or more below normal. Fair broods are produced when precipitation in May is nearly, or only slightly above, normal, while poor crops are probable when rainfall in May is about twice normal. If the findings in Colorado County apply to other parts of the coastal country, 2 years in 5, on the average, are favorable to prairie chicken reproduction, 2 are fair, and 1 is poor. Conditions affecting reproduction are never the same for the entire range, for a county, or even for different parts of the same county, because of the scattered character of local rains. Attwater's prairie chicken is a highly fluctuating subspecies, its scarcity or abundance depending to a large extent on the precipitation in May.

The annual kill of these birds cannot be intelligently regulated by such general open seasons and general bag limits as have applied in Texas in the past, but should be set, when permissible at all, by regulation by the State Conservation Department on the basis of the latest detailed information obtainable.

Optimum prairie chicken range apparently consists of well-drained grassland supporting some weeds or shrubs as well as grasses, the cover varying in density from light to heavy; and with supplies of surface water available in summer. In short, diversification within the grassland type is essential.

Management usually will involve protection against excessive killing, improvement of food and cover, moderate control of predators, and wise regulation of the harvest. Responsibility for management must be assumed by the landowner. Food and cover deficiencies can best be recognized and their improvement and maintenance assured by careful counts of the birds on part, or all, of the managed area at three critical periods in March, July, and December.

To obtain and maintain favorable food and cover, the following general practices are recommended: (1) Moderate grazing of pastures; (2) completing all necessary pasture burning before February 1 and leaving unburned not less than 40 percent of the best drained ground; (3) mowing pastures after July 1 and preserving the native cover on knolls, around ponds, and in flats; (4) allowing windmill tanks to spill over in summer to increase the supply of surface water; (5) controlling the numbers of feral house cats and predatory dogs; and (6) allowing the shooting of not more than 35 percent of the *known* prairie chicken population in any year when rainfall in May is normal or below and prohibiting killing when rainfall in May is approximately twice normal or above. Hunting seasons should not open before November 15.

Under normal conditions hawks, owls, and fur animals do not appear to be serious predators on Attwater's prairie chickens, and should not be killed indiscriminately.

Persons should not request the Government to furnish prairie chickens for restocking, because there is no surplus for the purpose and no evidence that the birds can be successfully transplanted.

In the absence of ample reservations for the species all other favorable factors together cannot be counted on to save the bird from extinction. Before too late a large tract or tracts of suitable range should be established as a prairie chicken refuge by the Federal or State Government.

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